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ANÆSTHESIA TODAY.[1]

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DURING the past ten years revolutionary progress has occurred in medicine, in which anæsthesia has participated in no small measure. Apart from trichlorethylene and curare, the agents available are virtually unchanged, but knowledge of their application has been vastly improved. Synergistic anæsthesia, seemingly, has come to stay. The older concept of a single agent for all purposes is virtually discarded—and discredited. Now the actions of a combination of drugs are utilized to the best advantage, and their disadvantages are largely avoided. The responsibilities of anæsthetists have correspondingly increased, and so good training is essential.

The intervening war partly encouraged and partly hampered developments. Army authorities rightly preferred standard methods, but tended to rely too much on surgical opinions in these matters. Unique in the Australian forces, however, was extensive provision made for the use of nitrous oxide and oxygen in the field. The value of intravenous anæsthesia was largely overlooked in the earlier stages of the war, despite strenuous representations by informed persons. So, too, were those of cyclopropane gas, "heavy" solutions for spinal analgesia, "Neosynephrin" *et cetera*. Later, supplies and facilities improved, and selected personnel obtained valuable training in specialized methods. Civil workers in anæsthesia also made great contributions to the development of the specialty during the war. The demand for their services was heavy and onerous; they so demonstrated and fostered improved methods that today both surgeons and public alike unreservedly acknowledge the essential value of such innovations.

[1] President's address, read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

Since the end of the war, progress has been maintained. Diplomas have been established in Sydney and Melbourne, and more hospitals have appointed anæsthetists, honorary or paid, to their staffs. A welcome increase in those interested and qualified in better anæsthesia has occurred. The interests of those established in the specialty have been rather enhanced than prejudiced by the newcomers, since the demand for good anæsthesia is large and enlarging. The duty of the former is to accord proper encouragement, instruction and assistance to the latter. The rapidly increasing scope of surgery carries an imperative demand for more specialists; those established need not fear penury, but added security instead. Hence the facilities for training and practical experience must be improved, and the knowledge of the better informed more widely dispersed.

It is undeniable that the technical requirements of modern anæsthesia necessitate extensive study, good training and wide experience. The older casual approach and degraded status are now quite inadmissible. Nevertheless simple methods are best, within their scope, for exponents of average competence; indeed, well-given "open ether" is often far better than indifferent cyclopropane and curare. In expert hands both are valuable, and the latter are generally preferable when indicated. But fashion and fancy must not outweigh common sense. The limitations, both of agents and of users, must always be recognized and frankly acknowledged.

It is appropriate now briefly to review the methods and agents in current use, and to indicate some abuses. "Open" (perhalational) ether is of course the standard. In general it is given very well, and adequately meets ordinary surgical demands. The chief abuse is failure to maintain a good airway. "Endotracheal ether" is also widely and efficiently employed, both insufflational and inhalational (Magill) methods being used. The former is obsolescent, and neglect to preserve free efflux around the tube is sometimes evident. The obvious advantages of the latter are often vitiated by failure to ensure unobstructed exhalation by means of a wide-bore T-piece or Y-piece placed adjacent to the subject's head. Most users are aware of the

danger of ignition, yet some will employ pure oxygen as a vehicle—a risky practice indeed. Intravenous anæsthesia (thiopentone, hexobarbitone) has a wide vogue, and is highly popular with all concerned. The margin of safety is less than that of ether, if the imperative need for a clear airway and extra oxygen is ignored. Sometimes the capabilities of both agent and user are exceeded. There was a tendency, which is now declining, to employ intravenous anæsthesia alone for major operations or other unsuitable work (cholecystectomy, tonsillectomy *et cetera*). In expert hands, however, its applicability and safety are greatly increased. Spinal analgesia, now less popular than formerly, is still valuable. The various safeguards are generally well understood, but some do not sufficiently appreciate the principles and hazards involved. A wider recognition of the value and application of vasopressor drugs, especially "Neosynephrin", is desirable. Apart from low (sacral) "cover", the method should be reserved to those with special training. Regional analgesia is now increasingly employed by anæsthetists; its value is unquestionable. Absurdities are sometimes perpetrated—for example, the use of brachial plexus block when a simpler procedure will do. Special training is essential; hence the application of regional anæsthesia is the prerogative of experts. If it is well conducted, the results are most gratifying. If it is badly conducted, it is dangerous and cruel. A combination of regional analgesia with light thiopentone narcosis is excellent.

The scope of nitrous oxide and oxygen is now limited, although this method still has considerable vogue in dentistry. It is unsuitable, alone, for major oral surgery, because of anoxæmic and inhalational risks. The gases are useful as a vehicle for more potent agents (ether, cyclopropane) and as a supplement to basal narcosis (thiopentone, bromethol); the proportion of oxygen in the mixture must then be substantially raised. For major work a combination of nitrous oxide, oxygen and ether is popular, at any rate in teaching hospitals. There is a tendency for the inexpert to use it too freely. The older continuous flow method has been virtually discarded; use of the closed circuit with carbon dioxide absorption is the usual practice. Although this provides means for aiding respiration, especially in emergencies, the method demands careful attention. Valves may stick, tubes may kink, soda lime may become exhausted or oxygen supplies may fail. Cylinders may be wrongly coupled, with disastrous results. The fact that nitrous oxide will support combustion is frequently overlooked. Here, again, special training is essential.

Ethylene is now virtually discarded. It has a potency little greater than that of nitrous oxide, and is inflammable. Cyclopropane, however, is valuable, although its inflammability is great. It has considerable potency and low toxicity, despite a tendency to cause cardiac irregularities. It has regained much favour since the introduction of curare. It provides an excellent basis for the supplementary use of ether. Apart from complications of administration, it is too expensive for use by the inexpert. Vinyl ether and trichlorethylene are two innovations of some merit, if of limited scope. The former is little used; the latter is useful in oro-pharyngeal, neurosurgical, obstetrical and dental work, but its assessment is as yet incomplete. Refrigeration anæsthesia is occasionally useful; the procedure is tedious. Spinal or intravenous anæsthesia is generally preferable. Except in obstetrics, chloroform is rarely used, yet it still has an occasional absolute indication. However, its toxicity to heart and liver is undeniable.

The position today, then, is that the vast majority of anæsthetics are, and must be, given by the average doctor. As experience of the various methods and agents widens, so their safe applicability increases. Limitations are sometimes exceeded; economic considerations often encourage such transgressions. Generally, however, the needs of patients are suitably assessed and duly satisfied, more expert services being obtained when practicable. The availability of such help is increasing, and its desirability is being more widely acknowledged. In truly major modern surgery expert anæsthesia is quite indispensable; neither skilful venepuncture nor daring with the ether mask will serve its exigencies and demands. Thus specialists, while enjoying increased recognition, must constantly improve their knowledge and skill in order to fulfil their added responsibilities.

Applied Physiology.

Physiological considerations are of profound significance in the safe conduct of narcosis and anæsthesia. In the past, with "open" methods, a comfortable margin for error and transgression was generally available, especially with ether. If it is unpleasant to patients, ether is indeed safe in average hands, despite occasional abuses. Good breathing is favoured by the common "open" method of administration, not because of any intrinsic stimulant capacity of the drug, but by virtue of the mild hypercapnia and suboxygenation incidental to this mode of use. "Closed" ether, of course, was an atrocity which is now happily discarded, although sometimes wistfully extolled by older surgeons.

As was remarked at the fifth session of this congress in 1937, the motto of the anæsthetist should be "oxygen". Elaboration is now necessary; adequate oxygenation with adequate carbon dioxide elimination should be the ideal. So let the motto be "ventilation", with all its implications. These have reference, not only to pulmonary gaseous exchanges, but also to ventilation or aeration of all bodily tissues, especially the brain. Tissue cells demand a virtually constant environment, to the maintenance of which a large variety of integrated mechanisms contribute; external interference may readily disturb this balance. So, too, may internal deficiencies, either of structure or of function.

Despite the existence of compensatory mechanisms, deep anæsthesia or narcosis, however produced, inevitably causes hypoventilation. The effects of this vary greatly with the condition of the subject, and with the duration and severity of the operation. Some withstand such adversity without gross ill-effects, either immediate or remote; they remain unruffled or "do not turn a hair", as the popular and comforting phrase has it. More, however, suffer various disturbances, but duly recover satisfactorily from the physiological insults so imposed. But far too many are thereby exposed to danger, and sometimes to disaster as well.

Various measures of dubious merit have been, and still are, employed to improve this situation. Frequently carbon dioxide is given to stimulate the respiratory, and less evidently, the vasomotor centres, very often with excellent results. This measure is suitable for use over short periods and for special reasons—for example, to aid induction or intubation and to favour the lightening of deep inhalational narcosis. However, continuous use of carbon dioxide is quite unwarranted, since it tends to exhaust the nervous centres involved, leading to post-anæsthetic depression. An egregious fallacy indeed is to employ it to stimulate breathing during the use of curare. Alternatively, a variety of analeptic drugs may be used. These are frequently beneficial to the patient, but sometimes are merely a salve to the anxieties of the user and the other attendants (nurses *et cetera*). Again, extra oxygen may be given—an entirely commendable procedure, even if the coincidental accumulation of carbon dioxide in the body is disregarded. The correct remedy, however, is the provision of mechanical assistance to impaired external respiration, whether impairment is due to excessive premedication, to deep narcosis, to high spinal analgesia or to the use of curare. For this purpose a closed circuit gas machine is virtually essential; inspiration is then aided by synchronized manual compression of the reservoir ("rebreathing") bag of the apparatus. In addition, the rational application of physico-chemical support to internal ventilation, including its circulatory component, is obligatory. This comprises suitable intravenous therapy (blood, serum or saline transfusions) and the judicious use of vasopressor drugs (ephedrine, "Neosynephrin").

Unquestionably the essential function of ventilation, both external and internal, is the supply of oxygen to, and the removal of carbon dioxide from, the tissues. Even if the latter favours the dissociation of oxyhæmoglobin in the capillaries, any excess of carbon dioxide, gross or prolonged, is intolerable, since acidosis is likely. The effects of a deficiency of oxygen are obvious. Yet some would restrict oxygen intake in order to potentiate the action of narcotizing drugs. This practice also aggravates their toxicity. If partial, and reversible, histotoxic anoxia is the true explanation of narcosis, as seems probable, it is beyond human skill to attempt its intimate regulation. Rather must we provide, together with appropriate dosages of our narcotizing agents, sufficient oxygen for all tissue needs, and at the same time ensure the unhindered elimination of waste products. In the satisfaction of these requirements important technical considerations are involved, as well as due attention to respiration and circulation. Respiratory embarrassment, whether mechanical, functional or toxic, must be avoided or corrected. Circulatory deficiencies must be recognized, relieved or duly allowed for. It is imperative that suboxygenation, from whatever cause, is to be avoided.

Yet, too much of a good thing may be bad. Too much nitrous oxide, for example, is obviously so. The absurdity of giving, say, only 7·5% (57 millimetres of mercury) of oxygen with nitrous oxide is apparent when the significance of the normal tension gradient is appreciated, for to maintain the normal oxygen tension of 35 millimetres of mercury in the tissues, a partial pressure of about 150 millimetres of mercury is required in the external air. Conversely the idea of giving free oxygen, to the neglect of other safeguards, is highly attractive, but fallacious. No doubt it relieves the subject of the main deleterious concomitant of narcosis; yet it carries risks, the chief of which is localized or widespread pulmonary collapse should breathing be obstructed or otherwise arrested. The practice of "washing out" the lungs with oxygen at the end of an operation is thus risky; the patient may lapse into apnœa and atelectasis may occur. If such "flushing" must be done, it should be done with air.

Indeed, air is the best vehicle for all inhalational anæsthetics. Admittedly, some enrichment with oxygen, to compensate for the dilution caused by added volatile or gaseous agents, is advisable; but gross excess of oxygen is unnecessary. It is even dangerous, since it increases the explosibility of the mixture. In the giving of an excessive amount of oxygen, the importance of nitrogen in the lungs is either neglected or overlooked. By virtue of slow absorbability nitrogen plays an important part in the maintenance of alveolar patency, since it is taken up very slowly by the blood. Thus, in the presence of bronchial or bronchiolar obstruction, coughing and retching may relieve the condition, since retained inert gas helps to expel the foreign material. Unfortunately, the potency of nitrous oxide is so low as to require the virtual elimination of nitrogen, in order to permit the greatest possible concentration of the anæsthetic agent without undue suboxygenation. At best, however, the unaided use of nitrous oxide demands the potentiating effect of more or less severe oxygen deprivation. Therefore the method is suitable only for short and superficial procedures. In its extreme, and now largely discredited, application (McKesson), nitrous oxide and oxygen anæsthesia verges closely on fatal asphyxia. Further, an undesirable excess of carbon dioxide is an inevitable accompaniment, causing the subject to labour mightily. The diffusibility of nitrous oxide is its real safeguard; this permits of its rapid introduction and withdrawal, with corresponding inverse variations in the quantities of oxygen supplied. A strange feature of light nitrous oxide and oxygen narcosis is that, after prolonged administration, the proportion of oxygen may be increased to 70% or 80% without recovery of consciousness.

In recent years the advent of intrathoracic surgery has made imperative the study of hypoventilation during anæsthesia. The outcome has been a procedure somewhat inaptly known as controlled respiration. Formerly the application of continuous positive pressure (Sauerbruch) was practised, but this, while favouring oxygenation, hindered gaseous elimination. In fact, it might be described as obstruction in reverse. Further, it impaired the venous return of blood to the heart and so cardiac output, the consequences of which were grave if the situation was prolonged. Gradually the need for preserving adequate inspiratory and expiratory excursions was realized; the patient could not be expected to breathe properly without assistance. Again, the futility and dangers of giving carbon dioxide or analeptic drugs for this purpose were duly appreciated. Thus the modern practice was evolved; the anæsthetist aids inspiratory effort by a synchronized artificial rhythm, or takes complete control of the patient's respiration, after the abolition of all voluntary efforts, by a combination of narcosis, hyperventilation and curare. This procedure constitutes controlled respiration; whether the associated hypocapnia is deleterious has as yet not been determined. My own preference is rather for "assisted" respiration than for outright "control".

Such help should be applied in any state of depressed breathing during anæsthesia, whether due to curare or not; here neglect could well occasion discredit of a valuable adjunct to general anæsthesia. Awkward postures, especially the prone position, frequently cause impaired ventilation, both external and internal. In the conscious state two conditions only encourage prolonged tolerance of the prone position; the chief of these is the sound of enemy bullets overhead. During narcosis, with sensation abolished and the muscles relaxed, deleterious results are soon apparent. Both breathing and the venous return of blood to the heart are gravely impaired; the situation is at its worst when the surgeon demands two or three pillows under the patient's belly to facilitate lumbar laminectomy. Anæsthetists, then, must study carefully the influence of posture on the safety and survival of their victims; in furtherance of this surgeons must accord much latitude and sympathetic understanding, even if some inconvenience results.

In the foregoing, no great emphasis has been placed on cardiovascular factors. It is truly remarkable how hearts will beat, despite numerous deleterious influences, from about the fourth month of intrauterine life to the time of final dissolution. A comparatively primitive structure, the myocardium will carry on, despite gross adversity; so, too, the peripheral vascular mechanism. Here again, adequate ventilation in its widest sense is the essential safeguard. Unless changes have been irreversible, the handling of peripheral vascular failure or shock is now comparatively effective. Central failure, whether due to disorders of rhythm or of contractile power, is also capable of relief by rest, by the exhibition of digitalis and diuretics, by venesection *et cetera*. Obviously such defects should be corrected as far as possible before anæsthesia is contemplated.

Nevertheless the risk of primary cardiac failure cannot be ignored, even in healthy subjects. Certain anæsthetics, notably chloroform and perhaps cyclopropane, favour the occurrence of this grave emergency, attributed generally to the onset of ventricular fibrillation. Fear and adrenaline are significant predisposing factors when these agents are used. Yet primary cardiac failure may occur with the use of ether, and even of other less noxious drugs. It is an emergency of the first order, and early recognition is therefore essential. Usually it is said that cardiac arrest precedes cessation of breathing, a proposition difficult to understand or accept. In my experience, happily limited, the first sign is a rapid change in the colour of the blood from red to black. This occurs in a matter of thirty seconds and generally invites immediate surgical comment. Alternatively normal bleeding ceases, a slow black ooze being the only sign of circulation. On one occasion a few sharp inspiratory gasps preceded the more obvious manifestations of the condition. The essence of the situation is that the circulation must be restored within five minutes if irreparable brain damage is to be avoided. No time should be lost in looking for alleged stimulant or analeptic drugs; they will be ineffective anyway, since the circulation is arrested. The essentials in treatment are as follows: (*a*) Inflate the lungs rhythmically with oxygen, "Carbogen", pure air or exhaled air. Tracheal intubation helps. (*b*) Puncture the right auricle through the third right intercostal space, to initiate an impulse which may restore effective rhythm. Inject adrenaline or procaine if available. (*c*) Open the abdomen and "massage" the heart (that is, compress it rhythmically against the sternum). Meanwhile continue rhythmic inflation of the lungs, preferably with pure oxygen.

Comment.

The safe conduct of anæsthesia, then, demands satisfaction of many requirements. In their observance certain basic essentials are involved. The subject should be restored to reasonably good health beforehand. Nutritional defects may require increased protein and carbohydrate intake, as well as vitamin therapy. Anæmia must be treated by either oral, parenteral or intravenous means, including blood transfusions. Simple psychotherapeutic measures are important; patients should be treated individually, reassured and encouraged In this the preliminary visit and examination are of incalculable value. Finally, judicious premedication must be employed. Thus adverse physical, physiological and psychic factors are minimized, and the response to, as well as the effects of, narcotizing agents are rendered more favourable. Good judgement and technical skill will then procure satisfactory results.

Conclusions.

1. Modern anæsthesia, in its wider applications, demands enthusiastic study, specialized training, adequate facilities and suitable reward.

2. Although most anæsthetics are given by persons of average competence, the field of the specialist is rapidly expanding.

3. Ordinarily competent persons should restrict themselves to the simpler procedures. Both they and surgeons should take advantage of more expert services whenever indicated.

4. While simplicity in technique is generally admirable, specialized methods are indispensable in many cases.

5. The principle of synergistic anæsthesia, established by Gwathmey thirty years ago, is now increasingly utilized. Although sometimes derided, the procedure is highly rational.

6. The basis of good anæsthesia is extensive knowledge and careful observance of physiological principles. The intrinsic properties of the various agents are less important than the ability of the users.

7. The introduction of more complicated, yet useful, methods increases the obligations and responsibilities of anæsthetists.

8. "Adequate ventilation", in its widest sense, should be the motto of all anæsthetists.

9. Closed circuit inhalational anæsthesia will, if properly conducted, readily fulfil this ideal, especially in emergency circumstances.

10. Of many innovations, the application of curare is a striking advance which yet awaits final assessment.

11. The position today is one of continued inquiry and trial, which deserve all possible encouragement. Further improvement and progress are inevitable.

THE PRESENT POSITION OF CYCLOPROPANE.[1]

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IT is my purpose in presenting this paper to emphasize recent advances in experimental knowledge and clinical opinion rather than attempt a comprehensive survey, as cyclopropane has been in general use in Australia since 1935, and most practical anæsthetists are familiar with its first established and outstanding qualities. A number of excellent evaluations have been published from time to time, the most impressive being that of Waters in 1945. A striking change in the general attitude to this drug since then has been effected by the increasing use of curare. By permitting of elimination or alleviation of some of the disadvantages of cyclopropane, curare has increased our appreciation of some of the striking advantages of this drug compared with other general anæsthetic agents.

Pharmacology.

Cyclopropane is a respiratory depressant in all the deeper planes, this effect occurring long before vasomotor depression occurs. It is enhanced by all respiratory depressant drugs, but particularly by morphine, as Dripps has shown experimentally. Cyclopropane is a parasympatheticomimetic drug with laryngospasmodic and bronchoconstrictive effects, enhanced by pituitrin, and by surgical stimulation of susceptible reflex areas in light anæsthesia. This is probably prevented, at least in part, by atropine or scopolamine, and possibly also by nitrous oxide (Waters's suggestion).

In normal cyclopropane anæsthesia in a normal subject without overdosage, the pulse rate will generally be about 70 per minute, whatever the previous rate. The most striking effect of cyclopropane is a tendency to disorders of cardiac rhythm (bradycardia, various irregularities, ventricular extrasystoles, tachycardia *et cetera*), and it is now accepted that though these may occur at various and not always strictly comparable planes, they occur in deep anæsthesia and can be abolished by reduction of cyclopropane concentration. Recent work on dogs by Stutzman, Murphy, Allen and Meek confirms previous work of these authors and of earlier workers in establishing that cardiac irritability is increased and the tendency to aberrant rhythms of all kinds, up to ventricular tachycardia and arrest, is greatly enhanced by adrenaline. Stutzman and his co-workers state that the reflex receptors are distributed for the most part in the peripheral three centimetres of mesentery. Impulses travel by visceral afferent fibres through the cœliac and superior mesenteric plexuses, the splanchnics and the spinal cord, to a brain centre above the pons, from which efferent impulses pass to the heart through the cardiac sympathetics.

It is fairly generally agreed that the effect of cyclopropane on blood pressure is slight, and that most reported effects are due to concurrent carbon dioxide retention, or to rapid elimination after retention, rather than to cyclopropane itself. This point will be discussed in more detail later.

[1]Read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

Arterial pressure is well maintained, especially diastolic pressure; Dripps states that there is a rise in venous pressure, which he ascribes to two factors: (i) increased cardiac output in all but the deeper planes, probably due to slowing with increased diastolic filling; (ii) a rise of circulating blood volume, mostly due to a rise in the number of circulating red cells. Dripps ascribes the increased capillary oozing of cyclopropane anæsthesia to atonic dilatation of the capillary walls in association with this increase in circulating blood volume. It can obviously be contributed to by the vasodilatation and raised blood pressure of unrecognized carbon dioxide retention. The clotting and bleeding times of blood are unchanged.

Gastro-intestinal motility and contraction are abolished in the deepest planes, but quickly restored on recovery. Cyclopropane has no effect on the liver. There is a rise in the fasting blood sugar level in the normal individual, but not in diabetes. Urinary secretion is depressed, but is quickly recovered and compensated. The effects on metabolism are slight. Cyclopropane has an affinity for fatty tissue, and fifteen minutes is the approximate time for tissue equilibrium to be reached. It is quickly eliminated unchanged, chiefly through the lungs.

Uterine contractions are not abolished except in deep planes, and are quickly restored. The fœtal circulation takes fifteen minutes to reach the maternal saturation of cyclopropane. In work on pregnant rabbits, Rosenfeld and Snyder showed that cyclopropane has less effect than any other inhalational agent, not even excepting nitrous oxide, in inhibiting fœtal intrauterine respiratory movements.

Technique of Administration.

No essential alterations have occurred in the mechanics of administration. On account of its expense cyclopropane is always given by the carbon dioxide absorption method. It is important that the system should be gas-tight from the beginning of anæsthesia, as leaks cause loss of inert gases in the early phases of anæsthesia. This favours post-operative pulmonary atelectasis by absorption of oxygen from the alveoli if subsequent failure of alveolar ventilation should occur. Explosive risk is also increased by a leaking system. Cyclopropane is explosive in a range of 2% to 10% in air, and 2% to 63% in oxygen, which is more than the whole anæsthetic range (between 7% and 40%). Dripps has published experiments which tend to confirm suggestions of many workers and clinical observers, not only that variations of blood pressure during cyclopropane anæsthesia are due to faulty elimination of carbon dioxide (when a rise occurs), or to elimination of carbon dioxide following a previous carbon dioxide build-up (when there is a sharp fall), but also that the well known phenomenon of "cyclopropane shock" familiar to all anæsthetists at the end of cyclopropane anæsthesia (and, I find on inquiry, very familiar to nursing staffs) is due to rapid elimination of carbon dioxide with the deeper breathing of recovery, after a previous unnoticed rise due to carbon dioxide accumulation. Dripps considers that carbon dioxide accumulation occurs because cyclopropane in the deeper planes causes respiratory depression before depression of the vasomotor centre, which responds sensitively to changes in carbon dioxide concentration. This effect was reproduced by Dripps in one case with light thiopentone anæsthesia accompanied by respiratory depression caused by curare, and I have seen clinical evidence of a similar phenomenon with these two drugs. The same effect is not seen in deep thiopentone or other anæsthesia causing comparable respiratory depression, because then the vasomotor centre is depressed concurrently with the respiratory centre, and carbon dioxide accumulation goes undetected. Morphine with cyclopropane increases this effect in direct relation to its contribution to respiratory depression (10% to 12%). Therefore the closest attention is necessary to the details of administration, and this should include elimination of all possible "dead space" in the breathing system, the most efficient carbon dioxide absorption being aimed at. In this connexion it is probably insufficiently realized that in anæsthesia for weak patients and particularly for small children, excessive "dead space" becomes important on account of their low tidal respiration, so that special apparatus is necessary for safe cyclopropane anæsthesia for a small child.

Respiratory depression should be eliminated as far as possible by reduction of sedative premedication and elimination of morphine; and by assistance to respiration, especially when cyclopropane is being used with curare. A perfect airway is essential and should include more use of endotracheal methods, which tend to be rather overlooked in cyclopropane anæsthesia, and which are essential, in my view, if it is used with curare.

If cyclopropane is given in oxygen, a gradual reduction of oxygen concentration to that of normal air towards the end of anæsthesia will assist in establishing normal respiratory and circulatory conditions. Dripps has also suggested that a fall of blood pressure in the recovery period may be treated by the administration of small percentages of carbon dioxide.

Previous mention has been made of the inadmissibility of adrenaline. Not so well known is the effect of pituitrin. Belinkoff, in reporting two deaths, has given warning of the condition of pituitrin sensitivity, which is likely to be exacerbated by cyclopropane. Pituitrin has parasympatheticomimetic effects of bronchospasm, laryngospasm and hypertension, with or without cardiac arrhythmias, and in these acts synergistically with cyclopropane. Together they may cause intensive coronary constriction and ventricular failure, or massive pulmonary collapse.

Lately suggestions have been made that, except in anæsthesia of those patients obviously in want of higher than normal oxygen atmospheres, there will not be the benefit at first ascribed to high oxygen concentrations, though experiment has not established suggestions of an actual toxic effect of oxygen, at least for ordinary operating times. A combination of oxygen saturation of the alveoli with respiratory depression, either during operation or post-operatively, will tend to cause pulmonary atelectasis when the oxygen is absorbed and not replaced by inert gases. Therefore, Waters considers that for patients not suffering from actual or potential anoxia, cyclopropane is better given in oxygen percentages approximately those of normal air, or at least not much above. An important point has also been made by Waters that high oxygen percentages tend to lead to carelessness in administration and failure to detect respiratory depression and obstruction, and so to carbon dioxide accumulation.

Methods of administration vary. During anæsthesia with the use of curare it is probably best to work with known low percentages, even if there may be a preliminary loss of the inert expired gases. In this connexion it is interesting to observe that some anæsthetists are able to make a good guess at cyclopropane percentage by smelling the contents of the breathing bag.

Premedication.

As far as premedication is concerned, there has been little change in our views. Most writers emphasize earlier suggestions that, on account of its effect in contributing to respiratory depression and also because it increases the tendency to cyclopropane bradycardia, morphine should not be given. The barbiturates, though they do not apparently, as earlier thought, offer protection against arrhythmias, suitably enhance the effect of cyclopropane and enable lesser concentrations to be used. However, emphasis is now on smaller doses and shorter-acting drugs, as with most other inhalational anæsthetics, it being borne in mind that minimum post-operative effect and quick recovery of reflexes and consciousness lead to lessened respiratory and circulatory complications. To this end, induction with a small amount of thiopentone is a pleasant and satisfactory way of establishing smooth cyclopropane anæsthesia, and need not contribute much to its respiratory depressant tendency. Secretions are not usually troublesome with cyclopropane, but laryngeal, bronchial and vagal reflexes may be; therefore, preliminary small doses of atropine or scopolamine are thought to be necessary. Waters considers scopolamine to be some protection against these reflexes.

Signs of Anæsthesia.

The signs of anæsthesia are few and not strictly classifiable according to Guedel. However, with quick passage through the early stages, little tendency to excitement and a quieter respiratory excursion than with nitrous oxide or ether, they follow the general pattern of inhalational anæsthesia, in that skeletal muscles relax before abdominals; upper abdominal relaxation or, as Orton and Kaye call it, "quiescence", occurs at a deep plane only narrowly separated from that of severe respiratory depression or arrest. The importance, then, of supplementary methods of relaxation is obvious. Endotracheal intubation is desirable for anæsthesia in upper abdominal surgery, as better relaxation is achieved with less necessity to "push" the anæsthetic drug; and the use of curare, though it offers the risk of increasing respiratory depression, does not necessarily produce this. If such respiratory depression occurs, it is less to be feared than that of deep cyclopropane anæsthesia, as it is more readily handled by assisted or if necessary controlled respiration, it is usually comparatively transitory, and it offers less damage to cell metabolism than strong concentrations of cyclopropane. It is now well recognized that, from the point of view of tissue metabolism. it is the deep planes of anæsthesia which are damaging, whatever the drug used. Laryngeal and bronchial reflexes may be active in the early planes, and are often excited by a too rapid increase in cyclopropane concentration. Waters emphasizes the importance of a gradual and slow approach to full cyclopropane anæsthesia in order to facilitate stabilization on a level and minimum plane, and also to avoid, as far as possible, the occurrence of these reflexes. In spite of reports of its possessing a broncho-constrictive effect in dogs, and occasional accounts of such an effect in man, curare is practically useful to subdue these respiratory reflexes, and facilitates intubation and toleration of an endotracheal tube in light planes of anæsthesia.

Eye signs are of slight practical use. Eyeball activity ceases in the deeper planes; when muscular relaxation occurs the pupils are usually small until overdosage is reached, when they may dilate. As always, respiration is the main guide, and when it is depressed by deep anæsthesia or curare, the pulse rate and rhythm become of supreme importance in warning of overdosage. In such conditions I believe that the administration of known maximum percentages is an extra safeguard, though obviously the state of the patient must be of paramount importance in deciding whether a known percentage is safe.

Indications for Cyclopropane.

As a general statement, cyclopropane is at present the most useful agent for all "bad risk" patients, because its potency in low concentrations and rapid elimination lead to flexibility of administration. In states of actual or potential anoxia, this makes possible the administration of concurrent high oxygen percentages. Limitations to its use are usually imposed by technical rather than clinical considerations, these contra-indications being the use of the diathermic cautery or other source of ignition, the necessity of its administration with a closed circuit machine, and the use of adrenaline or pituitrin.

In neurosurgery it is usually avoided, because of the tendency to capillary oozing and the usefulness of the diathermic cautery in this field.

In thyreoid surgery, cyclopropane has two indications; in toxic thyreoid states the high concurrent oxygen concentration is very useful on account of the raised basal metabolic rate of these patients; only light planes are necessary, but local anæsthesia of the pharynx, larynx and trachea is required if an endotracheal tube is used. In operations for obstructive thyreoid conditions cyclopropane is the anæsthetic agent of choice. In these operations a high oxygen atmosphere is often essential. Hewer and Rowbotham state that cyclopropane can be given with advantage in these cases with an inert gas such as helium, up to 50%, such an anæsthetic mixture offering less resistance to respiration.

Cyclopropane is essential for most intrathoracic procedures on account of its flexibility of control and the high oxygen percentages which can be used. It is also the easiest drug, in combination with other respiratory depressants, morphine, thiopentone and curare (the last-mentioned being also used for subduing laryngeal and bronchial reflexes) for the institution of effective "controlled respiration" with really light planes of anæsthesia; therefore all pulmonary procedures, mediastinal surgery, and the comparatively new field of surgery of the great vessels in the thorax call for the use of this agent. In this connexion Harmel and Lamont, and Orton, have emphasized that cyclopropane is an essential agent for use on the subjects of congenital pulmonic stenosis, cyanosed and anoxic as they usually are. In no other field of anæsthesia are the results of anæsthesia with cyclopropane so impressive as in thoracic surgery; the normal appearance during a long period of a "poor risk" patient exposed to major disadvantages of posture and almost every kind of mechanical respiratory disability and surgical interference, his respiration made effective by the anæsthetist, his circulatory system and general metabolism hardly affected by reason of the low percentages and light planes of anæsthesia used, his rapid recovery of function, normal respiration, coughing and consciousness, and his early ability to take nourishment, make a most impressive picture; and in no field are the results of a well-given anæsthetic so good—Orton's incidence of post-operative vomiting in such cases is about 5%.

In abdominal surgery, a recent advance in connexion with cyclopropane is of immense importance—that is, the use of curare. Without this drug, a skilful administrator can usually produce adequate relaxation for deep abdominal and upper abdominal procedures; but the margin between upper abdominal relaxation and respiratory arrest is very narrow, and favours carbon dioxide retention with its attendant toxic effects and risks; while the use of such deep planes for any prolonged period offers undue insult to general tissue metabolism. Though a minimum plane of anæsthesia is necessary, it is easy to provide, and moreover to change with rapidity, if cyclopropane is used and curare relied on for muscular relaxation. It is desirable to keep the patient breathing adequately; but respiratory depression and arrest, if from curare rather than from cyclopropane, are to be respected rather than feared, and can be readily dealt with if technical arrangements have anticipated the necessity. The only time during such anæsthesia when any deep plane from cyclopropane should be permitted is for closure of the abdominal wound, when it is preferable to further dosage of curare for this purpose, as the patient must be fully freed from curare by the time he leaves the anæsthetist's hands. For major abdominal procedures, especially on unfavourable types of patient such as robust muscular subjects, this technique offers more readily controlled and smoother anæsthesia with quick recovery and minimum toxic after-effects. In this connexion its use with major upper abdominal and deep pelvic surgery, especially abdomino-perineal and perineo-abdominal excisions of the rectum, is becoming increasingly favoured.

From the point of view of the risk presented by the patient cyclopropane is the most useful anæsthetic agent in shock and severe hæmorrhage. Hershey and Rovenstine investigated the effect of various anæsthetic agents on cats and dogs subjected to hæmorrhage, and found that under cyclopropane anæsthesia the mean blood pressure and the pulse pressure were higher and the pulse rate was lower than with other agents. This effect is independent of the use of a high oxygen inhalation. Zweifach, Hershey, Rovenstine, Lee and Chambers also investigated this matter from the point of view of peripheral blood flow, which was more efficient and better maintained under cyclopropane anæsthesia than with other general anæsthetic agents, while dogs subjected to local or cyclopropane anæsthesia tolerated the greatest blood loss. All these workers agree that these statements apply for the light rather than the deep planes of cyclopropane anæsthesia.

For any type of pulmonary disability, tuberculosis *et cetera*, cyclopropane is the anæsthetic agent of choice, because it is non-irritant and can be administered with a high oxygen percentage.

In cardiac disabilities of all types it is also the most useful anæsthetic. Although theoretically the tendency to cause arrhythmia led to warnings against its use for patients suffering already from arrhythmia, practically this objection does not appear to be of great moment. To quote Waters, "these patients tolerate poorly physiologic insult of any sort", so that every perfection of technique and skill should be rendered them. Belinkoff has stressed the necessity in such cases of avoiding three things: (i) anoxia of cardiac muscle; the coronary circulation, being dependent on diastolic pressure, is well sustained with cyclopropane; (ii) a low oxygen intake—easily corrected when cyclopropane is used; (iii) excitement during induction—so that adequate sedation and quick and smooth induction, such as cyclopropane can give, are necessities.

In this connexion it is interesting to observe that Belinkoff also advises against cyclopropane in congestive types of cardiac failure associated with pulmonary congestion and œdema. He regards spinal anæsthesia as a physiologically sound choice, and states that any form of general anæsthesia for this type of cardiac patient may precipitate a severe form of cardiac failure with acute pulmonary œdema.

In hypertensive conditions, with or without nephritis, cyclopropane is excellent, having little effect on blood pressure in the absence of carbon dioxide retention. It is useful in general toxæmias, jaundice and uræmia for its quick elimination by the lungs and slight effect on liver and kidneys. It is also useful for diabetics, on whose fasting blood sugar level it has no effect.

In genito-urinary surgery, particularly prostatic surgery, cyclopropane is frequently the anæsthetic of election. For suprapubic prostatectomy cyclopropane is the most satisfactory anæsthetic. It can be used with, perhaps, one injection of curare for robust subjects, but for the very old and weak satisfactory relaxation can be easily obtained with cyclopropane alone. To digress a little in this connexion, the use of curare has shown us that these operations can be performed with much less elevation of the foot of the table than was used formerly, and when the subject is spare they can often be performed with the operating table level. I believe that this is an important point when such potent respiratory depressants are being used on aged people. The new retropubic operation of Millen requires the use of the diathermic cautery, so that cyclopropane is contraindicated, and in my view no other suitable anæsthetic agent quite takes its place. It is gratifying to see, as I have many times seen, a patient aged seventy or eighty or even ninety years, often weakened by months of urinary obstruction, and usually with some degree of circulatory disability, undergo a major operation such as prostatectomy one afternoon, and sit up the next morning to enjoy his breakfast and call for the daily paper.

In the operation of endoscopic prostatic resection, cyclopropane for the worst "risks"—and some of them are very bad—is preferred to low spinal block.

In old age generally the high oxygen concentration and the lack of disturbance of blood pressure, either upwards or downwards, are great advantages, while cyclopropane controls old and weakened muscles with ease.

In obstetrics cyclopropane has a favourable effect on uterine contractions, which are not abolished in the lighter planes, and also, as was mentioned before, on fœtal intrauterine respirations, tending to a lessened incidence of *asphyxia neonatorum*. It is therefore suitable for all obstetric operations and has been used for obstetric analgesia. In this country its use is mainly limited in obstetrics to "bad risk" patients (that is, those with toxæmia, tuberculosis, heart disease), and to the Cæsarean operation, for which it is the anæsthetic of election. Fœtal and maternal equalization of cyclopropane percentages occurs in fifteen minutes. If delivered after this time the fœtus may have depressed respiration, but is usually quickly resuscitated. The uterus contracts well after delivery, and there is a lessened incidence of retained placenta.

For surgery of children, cyclopropane is useful in the worst cases of shock and hæmorrhage, either real or potential, and in thoracic surgery. The difficulties, however, are greatly increased in the small child by technical considerations, and by the difficulties of avoiding carbon dioxide retention, due to excessive "dead space" in the apparatus used. Unless exacting criteria can be satisfied as to such accumulation, it is better to give cyclopropane by a continuous flow non-absorption technique, such as through an endotracheal tube with an Ayre's T-piece, or to use some other drug altogether.

The closed method of administration interferes considerably with heat loss; in procedures on the "toxic" and febrile child, especially in hot operating-theatre conditions, this fact becomes of considerable importance from the point of view of the possibility of anæsthetic convulsions, and should always be borne in mind.

Sequelæ.

Post-operative nausea and vomiting are greatly reduced in comparison with ether anæsthesia, and are seldom troublesome or persistent, but they do occur in up to 40% of cases, in short administrations as well as long. The incidence has been greatly reduced by the use of the light planes possible with curare.

The record of cyclopropane as far as post-operative respiratory complications are concerned is good, as one would expect from its non-irritative qualities and quick elimination. Warnings previously given as to undue sedation should be emphasized, and also the importance of replacing the high oxygen percentage with air or some inert gas some little time before the conclusion of the anæsthesia.

Recovery from this gas is often so quick that the patient may suffer from severe pain, and the shock severe pain may cause, before he is given his first morphine injection. My personal preference is to have this injection ready at the end of the anæsthesia, to be given when the patient has reacted well and recovered consciousness, very often some time before he reaches his bed. Provided he will cough and ventilate his lungs when asked, I can see only harm in excessive post-operative pain and restlessness.

Conclusion.

To recapitulate, the recent aspects of cyclopropane anæsthesia which require most emphasis are the following: (i) its use with curare, with which it is in most cases the drug of election, owing to its flexibility of control; (ii) the importance of the fact that light planes of anæsthesia are so much less toxic and damaging

to tissue metabolism than deep planes; (iii) the supreme importance of maintaining adequate respiratory exchange by all clinical and technical means, with due appreciation of the toxic effects of carbon dioxide accumulation, and the contribution which such an accumulation and its subsequent elimination makes to the problem of "cyclopropane shock".

It is relevant also to stress that no advance in technical or clinical knowledge has altered the fact that, owing to its potency, its tendency to early respiratory depression and its comparative lack of clinical signs, cyclopropane administration should not leave the domain of the anæsthetist with special skill and knowledge. It is possible for most administrators to produce anæsthesia with cyclopropane; many of these will probably be able to satisfy the operative requirements of the surgeon. But for the anæsthetist to satisfy himself, or another critical anæsthetist, is the final criterion of the worth of any drug, and only the skilled anæsthetist will produce with cyclopropane the satisfactory results of which it is capable. In the hands of the ignorant and inexperienced cyclopropane is a dangerous drug; in skilful hands it is an invaluable one.

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THE TEACHING OF ANÆSTHESIA IN NEW SOUTH WALES.[1]

By S. V. MARSHALL,

Sydney.

Undergraduates.

UNDERGRADUATES receive 10 lectures, including films, from Dr. W. I. T. Hotten, the lecturer in anæsthesia at the University of Sydney, during the last term of fourth year or early in fifth year.

According to their allocation in successive groups to the four teaching hospitals (Royal Prince Alfred Hospital, Sydney Hospital, Saint Vincent's Hospital and the Royal North Shore Hospital of Sydney), they administer six or more ether anæsthetics under the supervision of the tutor or tutors in anæsthesia appointed either by the university or by the various hospitals. In addition, they receive tuition from resident anæsthetists and other senior resident medical officers of these hospitals, as opportunity arises. At Saint Vincent's Hospital and Sydney Hospital each student is required to keep a record of his administrations, which is inspected before the requisite certificate of proficiency is signed by the tutor concerned. Informal tutorials are also conducted by the various tutors, to explain more advanced methods, such as endotracheal, intravenous and spinal anæsthesia. Emphasis is placed on the physiological basis of anæsthesia throughout. Students are encouraged, by the exercise of tact and perseverance, to obtain as many administrations as possible, without prejudicing the interests of resident medical officers and others. Dental students also receive five lectures on general anæsthesia, and are given demonstrations of various methods, especially endotracheal anæsthesia.

[1] Read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

Resident Medical Officers.

As juniors, resident medical officers administer one or more "lists" of anæsthetics per week, under the supervision of honorary anæsthetists, resident anæsthetists or senior resident medical officers. In general each officer spends two or more periods of three months each in giving anæsthetics for various surgical services (general, ear, nose and throat, gynæcological *et cetera*). During this time the officer will use mostly ether, but as his proficiency improves he will conduct supervised administrations of intravenous anæsthesia and perhaps low spinal analgesia. Instruction in the principles of endotracheal anæsthesia and training in tracheal intubation will also be undertaken at this stage.

On senior resident medical officers a larger responsibility is imposed, and considerably more latitude is allowed them. In general these officers, after preliminary instruction and demonstration, employ special methods freely. Subject to the supervision of honorary anæsthetists they use the various gas machines, and give numerous endotracheal, intravenous and spinal anæsthetics. In turn, they now play a large part in the training of their juniors. In their tours of night duty *et cetera*, they deal with a large range of urgent cases which frequently require special methods of anæsthesia.

A few hospitals employ resident anæsthetists, whose status varies from that of general drudge to that of well-qualified expert. In the latter case there are good supervision and coordination of the anæsthetic services within the hospital, as well as satisfactory liaison with the honorary anæsthetists. Research is aided, teaching is facilitated, malpractices are limited and disasters are minimized by the presence of such an officer. Most surgeons recognize the advantages of such an appointment. In other hospitals the various senior resident medical officers serve a term, usually three months, as anæsthetics registrar, and during this period valuable training and experience are acquired. One hospital (Royal Prince Alfred Hospital) provides a fellowship in anæsthesia with two years' tenure (at present vacant). At Sydney Hospital the resident anæsthetist also enjoys a two years' tenure of his position. He is especially encouraged to study and apply the various methods of regional anæsthesia, to compile statistics and to present periodical reports on the anæsthetic work of the hospital.

Post-Graduate Students.

For graduates the Post-Graduate Committee in Medicine in the University of Sydney organizes various courses, the chief of which are as follows: (i) general revision courses, in which two or more lectures dealing with anæsthesia (intravenous, spinal *et cetera*) are included; (ii) a course for the diploma in anæsthesia, comprising about 75 lectures on all aspects of the subject; (iii) week-end courses for local medical associations, wherein a request for one or more lectures on some practical aspect of anæsthesia (intravenous, spinal or endotracheal, the use of curare *et cetera*) may be made; (iv) periodical film afternoons or evenings, showing various aspects of anæsthesia.

In addition the various specialist anæsthetists will give demonstrations and instruction, covering two or three weeks, to visiting doctors, generally from country districts. Such arrangements are purely informal, and not subject to any remuneration.

Discussion.

From the foregoing it seems that the teaching of anæsthesia in New South Wales is as good as can be expected under present conditions. Admittedly opportunities for practical experience are largely lacking, but a useful start has been made. The establishment of an independent post-graduate hospital would improve matters greatly, giving those really interested in better anæsthesia the scope and opportunities they deserve. Meanwhile, the larger proportion of the anæsthetics must be given by the generality of doctors, whose training as students and as resident medical officers should be made as comprehensive as possible in the standard methods. Today this means a lot more than ether anæsthesia; it certainly includes intravenous and to a limited extent spinal anæsthesia.

In this arrangement the specialist has his place as teacher and as exponent of the more abstruse methods. A large part of his duty is to instruct in their limitations those inclined to adventure beyond their capacities. At the same time he must sustain and increase his own knowledge and skill, therefore requiring ample clinical material for these purposes. Hospital residents sometimes view askance the advent of honorary anæsthetists; they feel that their work and experience will be filched from them. Such should not be the case; not only does each side stand to benefit from cooperation, but surgeons and patients do so as well. In the past most surgeons have recognized the substantial contribution good anæsthesia has made to the progress of surgery, and have accordingly supported their staff colleagues in the effort to get proper facilities and recognition.

Thus the teaching of anæsthesia in New South Wales, while exhibiting many deficiencies, has a reasonably sound basis, and should be capable of great improvement in the future.

TEACHING OF ANÆSTHESIA IN VICTORIA.[1]

By A. L. BRIDGES WEBB,
Melbourne.

MY experience in teaching anæsthesia is relatively brief, as I have been on the staff of the Royal Melbourne Hospital for only about two and a half years. But it so happens that the last two and a half years have been very important in the development of anæsthesia in Victoria.

Before the war there were only five or six full-time anæsthetists in the city of Melbourne, and the methods used were mainly ether given by the "open" method, ether given by the intratracheal route, spinal anæsthesia, and to a limited extent nitrous oxide and oxygen anæsthesia. Now there are about 30 anæsthetists, and modern methods of controlled respiration with the use of cyclopropane and curare are well to the fore. Surgeons have been educated, and they now ask for these agents, as they have come to realize the great help they are to their work and the improvement they mean in the condition of their patients at the end of long and arduous operations. This means that the teaching of students is at present in a state of flux. Difficulties are being encountered in finding sufficient cases suitable for the methods taught, especially in view of the much larger numbers of students in each year.

Up till recently and especially during the war years, students were given a card with a space for 10 signatures. An autograph hunt then commenced, and the intensity of this hunt increased as the year progressed. Students received instruction from a varying number of anæsthetists at intervals of weeks or months, and finally with their card filled they were regarded as fully qualified. University lectures are given, but often the student comes for his practical work before he receives these lectures, or else so long afterwards that they are only a dim memory. The question of the agent in the use of which students should be given instruction was discussed at the meeting of the Australian Society of Anæsthetists in Adelaide last year and it was held that "open" ether anæsthesia meets Australian requirements. For safety, if not for the patient's comfort, ether is supreme in the hands of the relatively inexperienced. And indeed it has been a constant surprise how quickly students pick up the rudiments, and manage to give, if not a really good anæsthetic, at least an adequate one, in spite of the fact that the public hospital type of patient is by no means an easy subject.

At the Royal Melbourne Hospital since the appointment of a clinical supervisor about eighteen months ago, a lot has been done to overcome the disadvantages of the "free-for-all" autograph hunt. Arrangements are being made so that students will receive at least the major part of their instruction from one anæsthetist, and so that the instruction given is to some extent standardized. Among 15 individualists this has been somewhat difficult, but the present régime is one of standard premedication, ethyl chloride induction and "open" ether maintenance. The students come on in groups and are usually allotted to one of the four honorary anæsthetists. They are given a short lecture on the methods of administration, the main signs of anæsthesia in its various stages, and danger signs, and are advised what to read before the next attendance. The patient is then anæsthetized by the instructor. Having all attended twice as a group, they then receive individual instruction, and in order not to waste time they are allotted one to each operating session. During the individual instruction the elements of "open" ether anæsthesia are again expounded over the first two cases, but after this the instructor simply stands by to prevent either the killing of the patient or at the other extreme the undue annoyance of the surgeon. It is held that after demonstration and instruction it is better to interfere as little as possible, and to let the student learn as we did by trial and error. Questions are answered, but information is not forced on the administrator just when his mind should be fully occupied in solving his problems for himself. Towards the end of his series of cases he is shown how to visualize the larynx and told of the dangers and difficulties of "Pentothal" anæsthesia. In a short series of cases all that is aimed at is that the student shall be able to administer "open" ether with safety.

In the attempt to institute this system at the Royal Melbourne Hospital certain difficulties have been met with: (i) irregular attendance of visiting anæsthetists; (ii) the obtaining of sufficient patients suitable for "open" ether; (iii) apathy, and difficulty in persuading students that it is worth missing one of a series of 20 lectures in some other subject in order that they shall be present at the operating session to which they have been allotted.

1. With the present system of honorary service at teaching hospitals, it is difficult to find anæsthetists who are able to attend morning sessions regularly. Most private operating is done in the mornings, and a full-time anæsthetist finds it hard to earn a living if he gives up one-fifth of his earning time.

2. Naturally with more pleasant, if not safer anæsthetic agents available, it is seldom that a patient is set down for "open" ether, even though there are a number of orthopædic, gynæcological, and lower abdominal procedures, which are suitable for this method. With a growing number of students it has become necessary to direct that "open" ether anæsthesia shall be used except when the safety of the patient or the convenience of the surgeon demands some other method.

3. Without an examination it will always be somewhat difficult to persuade students that anæsthesia is an important part of their course, but it has been noticed that since the student has been attached to one instructor he is taking a much greater interest, and in a few rare instances they are actually attending for more than their 10 cases. This brings up a point that has been discussed among some of the anæsthetists—whether anæsthesia should not be left till the resident medical officer period of the student's career. Until a period of residency becomes compulsory after graduation, this is impracticable. At the best the present system is a compromise, and the real knowledge of how to give an anæsthetic comes during the resident medical officer period.

At the Royal Melbourne Hospital, as each batch of resident medical officers comes on they are compelled to give anæsthetics under the supervision of a visiting anæsthetist or of a senior resident medical officer. This is only partly successful, as wrong methods and ideas are passed on from one year to another. So far there has been no official instruction in more modern methods, and in fact no first-year resident medical officer is even allowed to pass a Magill tube; however, on the day when he becomes a second-year resident medical officer he is permitted to do so, even if he is not capable. During this second year, and in some cases in the first year, certain keen resident medical officers manage to acquire a good amount of knowledge and competency in the more advanced methods. Apart from instruction of resident medical officers, the real post-graduate training has to be considered. With the establishment of a diploma in anæsthesia at the University of Melbourne, some provision will have to be made for both instruction in the more advanced methods and experience in these methods. At present this is a personal affair, and is obtained by the candidate's going from hospital to hospital and watching trained anæsthetists at work. Dr. Orton has been most generous with his time and his knowledge, and the present high position of anæsthesia in Melbourne is undoubtedly due to his efforts. At the Alfred Hospital thoracic unit the number of those watching the anæsthetist is almost always greater than that of those who are interested in the work of the surgeon. In a city where a diploma is given, some arrangements should be made for continuity of clinical instruction and for an opportunity to put this knowledge into practice.

[1] Read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

Conclusion.

In this short address no attempt has been made to deal with the technical side; rather some of the difficulties in arranging for better teaching have been stressed. At the hospital where I work nothing is settled; we are aiming at the ideal, but so far have by no means achieved it. More ambitious schemes have been considered which will require vision and great effort to put into operation. A department of anæsthesia under the guidance of a highly qualified director is envisaged. He would have the assistance of one or more young graduates who intend to take up anæsthesia as a full-time specialty. This should be a great help, both in regard to improving the standard of anæsthetics, and also in putting teaching of both undergraduates and graduates on a better basis.

THE TEACHING OF ANÆSTHETICS IN SOUTH AUSTRALIA.[1]

By ALLAN LAMPHEE, M.B., B.S., M.R.C.P., D.A.,
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IT is a wise choice on the part of those who arranged the subjects for discussion at this meeting that the teaching of anæsthetics was included. Anæsthesia has advanced so much during the last twenty or thirty years that I sometimes fear that those of us who are engaged in teaching are in grave danger of losing a proper sense of proportion, or shall I say, a sense of values. Today a student in a teaching hospital sees anæsthetics of various types given, ranging from ether given by the "open" or endotracheal methods, spinal anæsthetics and intravenous anæsthetics to cyclopropane with or without some form of muscle-relaxing agent. It is easy to imagine that many complete their final year with only a vague idea of why a certain choice of anæsthetic is made, and with a still hazier idea of how to administer even "open" ether.

This immediately opens an important subject for discussion—namely, what to teach the student and what to leave him to learn for himself during his resident days. In the curriculum laid down by the University of Adelaide only six lectures are allowed for the subject of anæsthetics; this has remained unaltered for over twenty years. As to whether the number of lectures should be increased or not I will not express an opinion, except to say that I fully realize that the modern student has too many lectures to attend as it is, and one cannot argue against the fact that the art of administering anæsthetics can never be learned by reading, but only by the actual giving of anæsthetics. It is obviously impossible to cover the whole subject in six lectures, but I feel that the following points should be stressed: (i) the preliminary examination of the patient; (ii) the signs of the various stages of anæsthesia; (iii) the complications of anæsthesia and their treatment; (iv) premedication for the various types of anæsthesia and the reason for it; (v) immediate post-operative treatment, including oxygen therapy; (vi) the choice of anæsthetic agent. All these points can be dealt with in talking about ether given by the various methods, spinal anæsthesia, intravenous anæsthesia and the various gaseous anæsthetics. I find it impossible to go into any more detail in the six lectures allowed.

To come now to what I consider the more important part of the teaching of anæsthetics, namely, the actual instruction in the operating theatre with the student as the administrator. In this I feel that I can be more dogmatic. It is now over a hundred years since ether was first used as an anæsthetic. Many changes and fads in anæsthesia have come since then, but ether is still the best and safest general purpose anæsthetic. Fortunately also it is still the best anæsthetic for teaching purposes, for the following reasons: (i) because it is safe; (ii) because the various stages of anæsthesia are easy to define; (iii) because the student can be taught the value of listening to the breathing and correcting any obstruction to the airway. He encounters all the common complications of the induction stage and during the maintenance of anæsthesia, and can be taught more leisurely how to correct his mistake than with any other anæsthetic. I am convinced that a student who concentrates on giving "open" ether has learned more about the art of administering anæsthetics than one who has "had a shot" at most methods. Once he has learned the fundamental principles from his ether administrations, he can more intelligently apply the same principles to intravenous and gaseous anæsthesia.

Twenty years ago practically all the anæsthetics at the Royal Adelaide Hospital were ether administrations; some were given by the "closed" method by means of the Clover inhaler, some were given by a Shipway apparatus, a few were given by the endotracheal method, but in the majority of cases the "open" method was used. The number of students coming up for instruction was not large, and consequently those of us who graduated about that time received a thorough grounding in the administration of ether, for which Dr. Gilbert Brown was largely responsible. When we became resident medical officers there was no anæsthetic registrar and no post of resident anæsthetist. All the anæsthetics not given by an honorary anæsthetist were therefore given by resident medical officers, who were rostered for that purpose. It meant hard work, as much time was spent in the operating theatre which would otherwise have been spent in the wards; but at the end of a year I think everyone realized that he was quite at home with ether, at any rate. However, the position today is different. Although I have said that, in my opinion, major importance should be given to instruction in ether administration, I must admit that at the present time in Adelaide we are finding it impossible to carry this out as we would wish, owing to difficulties which I will discuss in a moment. These are difficulties to which at the present time I can offer no solution.

To go back once more to twenty-five years ago: as a general rule each honorary surgeon's operating session consisted of perhaps one lengthy operation, and this was followed by a series of shorter ones, such as herniotomies and appendicectomies. These were ideal for teaching purposes, and the students had ample opportunities for learning the induction and maintenance of anæsthesia.

Conditions have altered now; one seldom sees an appendicectomy or a herniotomy; these operations are usually performed by a clinical assistant or a registrar at times when an honorary anæsthetist is not present—the anæsthetic being given by a resident medical officer. All the "bad risk" patients are naturally operated upon on the routine operating days, and this means that the teacher in anæsthetics has to do most of his instructing on the difficult long procedures for which in many cases a more specialized type of anæsthetic is being given. Towards the end of such an afternoon there may be one or two short ether anæsthetics; but by this time both the anæsthetist and the students are weary, or at any rate I am, and the urge to teach has gone. Consequently, in order that the student may be "signed up" for the necessary twenty anæsthetics before graduation, one is more or less forced to include a proportion of administrations from which one feels that the student is not in a position to have learnt much. This applies especially at the present time, when the numbers of students have increased so enormously.

The position is not helped by the fact that later on, as resident medical officers, these same students will not be receiving the same concentrated experience in the administration of anæsthetics as the previous generation of resident medical officers.

It is a difficult problem, and one to which I hope this discussion will offer some solution. I have no doubt that similar difficulties are arising in other teaching schools.

The thing that I want to stress in this short paper is that at the present time we, as teachers of anæsthetics, are more or less forced to give instruction to students in methods and upon types of cases which are unsuitable. An instructor in clinical surgery should aim at teaching the fundamentals of surgery. He would be considered a bad teacher if he neglected the basic principles and laid more stress on the various steps in the performance of, say, a partial gastrectomy.

We must be on guard lest in the teaching of anæsthetics we neglect a thorough training in the administration of ether, because in my opinion the fundamental principles of anæsthesia can be properly learned only from the administration of ether.

Conclusion.

In this paper I have tried to stress the value of ether for teaching purposes. Any lectures given should be elementary, the stress being laid upon principles rather than upon the more technical details. More use should be made of selected cinematographic films to supplement the lectures. For the actual teaching in the operating theatre in hospitals where the honorary system prevails, I would suggest that in addition to the honorary anæsthetists, an adequately paid full-time instructor should be appointed.

[1] Read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

THE RESPIRATORY VALVE.[1]

By GEOFFREY KAYE,
Melbourne.

THE respiratory valve forms a structural component of an increasing percentage of appliances for anæsthesia. Its design is mechanically simple, yet of cardinal importance. In the case of an expiratory valve, restriction adds to the muscular effort of respiration. The results are unquiet breathing, imperfect relaxation of the abdominal muscles and eventual fatigue of the respiratory centre. The effects produced by a restricted inspiratory valve are still more promptly and decisively harmful. Inspiration is achieved only at the cost of excessive activity of the diaphragm, the intercostal muscles and, in extreme cases, the accessory muscles of respiration. An undue negative pressure thus results within the thorax during inspiration. Fluid escapes through the capillary endothelium into the pulmonary tissues. The resulting œdema is a potent cause of alveolar occlusion and consequent atelectasis. If the resistance to inhalation is gross, the excessive negative pressure within the thorax can soon lead to circulatory failure, probably from interference with the normal filling of the right side of the heart during diastole. It follows that, whilst a measure of expiratory resistance may exist for some time without serious consequences, inspiratory resistance soon embarrasses both the respiration and the circulation. Furthermore, a valve which is incompetent may interfere dangerously with the normal intake of oxygen and elimination of carbon dioxide within the anæsthetic system.

The safety of any appliance for anæsthesia, rescue or resuscitation is therefore dependent upon the design and workmanship of its valves. Good valves, too, must be maintained in good working order. The study of the design of valves, and of the

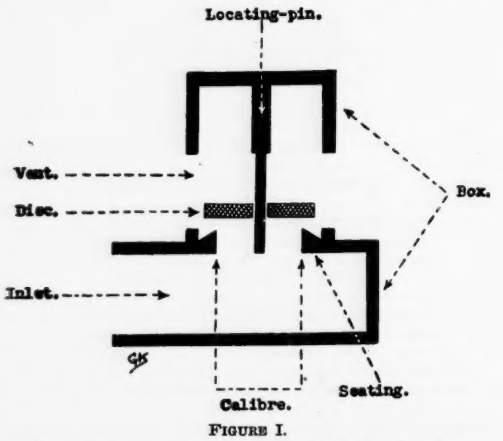

FIGURE I.
Structural components of an exhalational valve.

defects encountered in commercial samples of them, is of practical utility to the anæsthetist. It offers also a useful exercise in the applied physiology of respiration. Furthermore, precise standards for the design of valves have yet to be formulated; the difficulty in so doing is instructive and illustrates the complexity of the task before the Committee on Standards of the Australian Society of Anæsthetists.

General Principles of Design.

The respiratory valve consists usually, although not invariably, of a disk or flap which registers upon a machined seating. If the disk lies between the seating and the patient's lungs, the valve is obviously inspiratory. If the disk lies on the far side of the seating, the valve is expiratory.

The following terms, illustrated in Figure I, are used in connexion with the design of valves. (*a*) The box or body is that part of the structure which houses the seating and the channels which lead to and from it. (*b*) The seating is the machined surface, usually but not always annular, upon which the disk rests. (*c*) The term orifice is applied in this paper to the respiratory channel which traverses the seating, although this channel may have appreciable length and so depart from the strict definition of an orifice. (*d*) The calibre or bore is the internal diameter of the narrowest channel within the valve-assembly, being usually that of the orifice. (*e*) The vents are the channels through which, in an expiratory valve, the gases escape into the atmosphere after having lifted the disk from the seating. (*f*) The locating-pin or cage is a device employed in many valves to keep the disk aligned with the seating.

The valves illustrated in this paper will be expiratory. Identical principles apply to inspiratory valves, the essential difference between the two types being in the site of the disk and the seating. Further, a distinction must be made between the "ideal" design for a valve and its practical application. Under ideal conditions, the disk should be devoid of weight and unaffected by tilting, friction or adhesion. The orifice, too, should be without significant length, since the resistance offered by any channel depends upon its length as well as its diameter. Since these conditions cannot be realized in practice, the design of valves is necessarily subject to practical compromise.

The valves supplied by up-to-date manufacturers have a calibre of at least three-quarters of an inch and desirably of seven-eighths. Valves of smaller calibre restrict the breathing and are seldom permissible, especially if the motive power in the anæsthetic system is to be the patient's own respiratory efforts. The cross-sectional area of a circular channel is given by the expression $\frac{\pi.D^2}{4}$, where D is its diameter. The cross-sectional area of a channel seven-eighths of an inch in diameter is therefore $\frac{\pi.(\frac{7}{8})^2}{4}=0{\cdot}6$ square inch. This is generally accepted as the minimum for effortless respiration in the adult and the bore of modern valves is made to conform to it. The shape of the channel is of less importance than is its sectional area, although circular channels favour smooth and laminar flow. Laminar flow through valves is, however, scarcely practicable owing to frequent changes in direction by the flowing gases: none the less, it is well to contribute towards it by keeping rectangular bends to a minimum.

The lift of a valve is the vertical distance through which the disk is free to move away from its seating so that gases may escape. The area available for this escape is really that of the circumference of a cylinder, of which the base is the orifice and the height is the lift. This circumferential area is given by the expression $\pi.D.L$, where D is the diameter of the orifice and L is the lift. Further, if the valve is to be unrestricted, this circumferential area must not be less than the cross-sectional area of the orifice, which we have already seen to be represented by the expression $\frac{\pi.D^2}{4}$. We have, therefore:

$$\pi.D.L=\frac{\pi.D^2}{4} \text{ or } L=\frac{\pi.D^2}{4.\pi.D}=\frac{D}{4}$$

We thus arrive at the simple formula that the lift of any valve should equal one-quarter of its calibre. A standard valve, seven-eighths of an inch in calibre, should therefore have a lift of almost one-quarter of an inch. Less would mean restriction; more would add nothing to freedom and might well result in non-return of the disk to its seating at the commencement of inspiration.

The circumferential area of escape must coincide with the vents. However large these may be, their only effective portion is that which lies below the disk at its position of maximal lift. Again, the bottom of each vent must be level with the seating, otherwise work must be done by the patient in lifting the disk up to the vent before his exhalations can escape. Still further, the effective sectional area of the vents must not be less than the cross-sectional area of the orifice, otherwise the valve will be restricted. The actual form of the vents is less significant than is their total sectional area. In practice, an elongated form, of height equal to the calculated lift, is the most satisfactory. The long base, set flush with the seating, admits of the escape of exhaled gases as soon as the disk begins to lift. A vent of this shape is also easily machined.

It often happens, in such an appliance as a circle absorber, that the requirements of design oblige the vents to be put at a distance from the seating. The exhalations must now escape through the annular space, shown in Figure II, between the

[1] Read at a meeting of the Section of Anæsthesia, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

edge of the disc and the valve-box. If restriction is to be avoided, the cross-sectional area of this annulus must equal that of the orifice. Its calculation for a standard valve, seven-eighths of an inch in bore, is as follows. The disk, which overlaps the seating all around, may be taken as having a diameter of one inch. Its cross-sectional area, given by the expression $\frac{\pi.D^2}{4}$, is therefore equal to 0·78 square inch. The annulus must be given a further cross-sectional area of 0·6 square inch, making 1·38 square inches in all. If D is the internal diameter of the valve-box, we have:

$$\frac{\pi.D^2}{4}=1\cdot38, \text{ or } D=\sqrt{\frac{1\cdot38\times4}{\pi}}=1\cdot33 \text{ inches.}$$

It is therefore necessary to machine the valve-box to an internal diameter of approximately one inch and three-eighths.

The valves considered thus far have been suited to anæsthesia of a wholly "inhalational" type. Where the anæsthetic mixture is not merely inhaled, but is delivered under some degree of positive pressure, it was formerly the practice to use valves of smaller calibre. In McKesson's intermittent-flow apparatus, the smallest channels on the inspiratory side measured five-eighths of an inch, on the expiratory side three-eighths. It is now realized that this restriction, even though countered in part by gaseous *vis a tergo*, does not make for quiet respiration. Modern apparatus employs valves of wide bore even in positive-pressure work, useless dissipation of this pressure being prevented by means of spring-loading, as will be described below.

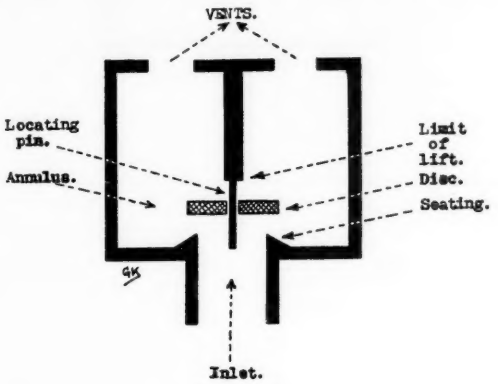

FIGURE II.
Design of an exhalational valve in which the vents are far removed from the seating.

Standard Types of Valves.

The valves ordinarily found in anæsthesia apparatus belong to one or other of the following types: (*a*) knife-edged, (*b*) spring-loaded, (*c*) caged-disk, (*d*) Rubber-sleeve, (*e*) rubber-flap.

Knife-edged Type.

A knife-edged valve is illustrated in Figure III (*a*). It may be either expiratory or inspiratory. Its seating is annular and is machined to a comparatively sharp knife-edge, the area of contact with the disk and the consequent adhesion being thus reduced. The disk is usually of linen impregnated with "Bakelite", this material approximating as far as possible to the ideal of a "weightless" disk, and being moreover strong, flat, quiet in operation and relatively non-adherent. Disks of aluminium are noisy in operation and are apt to adhere when wetted by the exhalations. Most of the other metals are undesirably heavy, although "Monel" metal is under trial. The locating-pin which traverses the disk has a diameter of one-sixteenth or three thirty-seconds of an inch, is highly polished to reduce friction and is placed at the centre of the orifice. Its purpose is to prevent the disc from moving laterally away from the seating and into the vents, which are always of large size in valves of modern design. The pin also helps to prevent tilting of the lifting disk, which might otherwise return edgewise to its seating and fall into the orifice, making the valve incompetent. A spring occurs mainly in expiratory valves, which may have to be used in positions other than the horizontal. Its function is to prevent tilting of the disk as it lifts and to aid its return to the seating at the beginning of inhalation. The spring necessarily limits the lift of the valve and adds to its resistance. It must therefore be of very light gauge, approximating to 0·015 inch in diameter, and should terminate one-eighth of an inch above the disk when the latter is in the position of rest. The commencement of expiration will then be relatively free, and resistance throughout the remainder of the lift will be the minimum practicable. Inspiratory valves, such as occur in circle absorbers and "inhalational" vaporizers, are meant to be

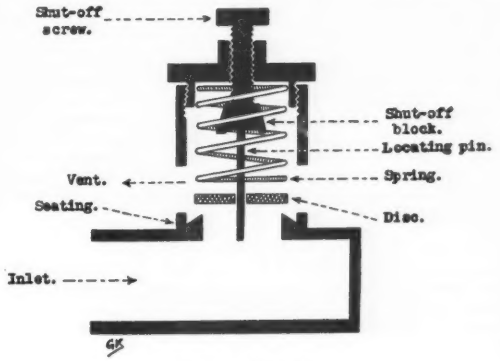

FIGURE III(*a*).
Diagram of a knife-edged valve.

used in the horizontal position. It is thus possible in their case to dispense with springs and to depend upon gravity for the return of the disc at the beginning of expiration. The slight resistance introduced by even the most sensitive spring is thus obviated. The shut-off mechanism is usually simple, having only "open" and "closed" positions. It need consist only of an obturating block moved by a threaded spindle, which for quick action usually has a multiple-start thread.

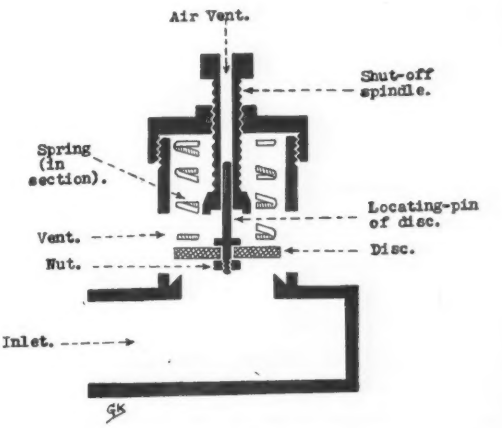

FIGURE III(*b*).
Diagram of an exhalational valve having a disk with an attached locating pin.

A sub-type of the knife-edged valve is depicted in Figure III (*b*). The locating-pin is here attached to the disk and is free to move within a channel drilled through the shut-off spindle. It must form a precise running fit within that channel, since either tightness or looseness will produce a binding action and add greatly to the resistance of the valve. The channel through the shut-off spindle must be open to the atmosphere, otherwise a piston-like effect will develop and hinder elevation of the disk. The whole design is an unhappy one, since, however carefully executed, it necessitates a comparatively heavy disk and so adds to resistance.

Knife-edged valves are widely used in circle absorbers, vaporizers, mask-assemblies and endotracheal valve-adapters. They are unsuited to anæsthesia under positive pressure unless their disks are spring-loaded, as will be described below. Their use in continuous-flow anæsthesia of the "semi-closed" type offers one practical difficulty: being sensitive, they may fail to retain the contents of the bag at a minute-volume of delivery much about the normal requirement of eight or ten litres. It then becomes necessary somewhat to restrict the lift of the disk by downwards movement of the shut-off block. When the back-pressure thus generated becomes equal to the elastic recoil of the bag, the latter will begin to expand. The alternative is to use, in this type of anæsthesia, a valve which is lightly spring-loaded.

The faults most often seen in commercial knife-edged valves are the following: (*a*) inadequate bore; (*b*) cancellation of adequate bore by the fitting of some nipple or appliance of smaller bore; (*c*) flatness of the seating; (*d*) provision of vents having a total cross-sectional area less than that of the orifice; (*e*) placing of the vents above the seating instead of on a level with it; (*f*) restriction of the lift; (*g*) provision of an unduly heavy disk or of one which lacks a locating-pin; (*h*) provision of a spring of excessive length or stiffness.

The Spring-loaded Type.

The spring-loaded valve is a specialized one, intended for use where the anæsthetic mixture is delivered under positive pressure. Its employment for other purposes is usually undesirable. Its structure is shown in Figure IV. In calibre and general design,

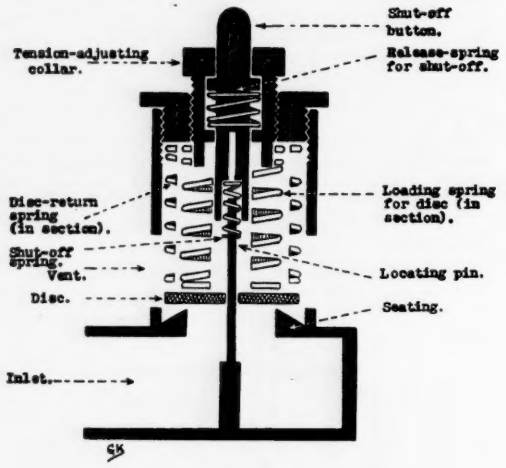

FIGURE IV.
Diagram of a spring-loaded knife-edged valve.

it conforms to the modern standards for knife-edged valves. It has, however, a second spring, which can be made to impinge upon the disk and offer progressive resistance to its lifting. The valve is correctly set when it transmits expiration comparatively freely, but allows no gas to escape during inspiration. Each change in the pressure of delivery of the anæsthetic mixture must therefore be met by a corresponding readjustment of the amount of spring-loading of the disk. The gaseous pressure will then be transmitted effectively to the patient's respiratory tract, yet there will be no needless loss of gases and expiration will not be more hampered than is inevitable in this type of anæsthesia.

Spring-loaded valves often show great complexity and originality of design, but their principles of operation are as illustrated in Figure IV. They may bear a thumb-piece which carries a third spring, the function of which is to admit of instantaneous closure of the valve should it be necessary to inflate the patient's lungs with oxygen. In this event, the thumb-piece will probably bear yet a fourth spring, designed to hold it out of operation until it is required. An index and pointer are usually provided, purporting to show the pressure which can be sustained beneath the disk before it starts to lift. This index is in the highest degree approximate. Its values will be affected by the temperature of the surroundings, by the presence of exhaled moisture and by the possible existence of metallurgical "fatigue" in the spring. The final adjustment of the spring-tension must always be based upon clinical observation of the patient's breathing and of the behaviour of the intermittent-flow mechanism of the anæsthesia apparatus.

The faults commonly found in the spring-loaded valve are those of the knife-edged valve from which it evolved. In addition, manufacturers have been known to augment the spring-loading until no position exists in which it is inoperative.

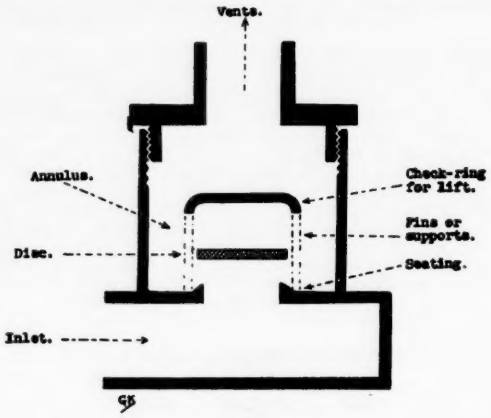

FIGURE V(*a*).
Diagram of a caged-disk valve.

In this event, the valve will offer resistance to the breathing whenever the pressure of delivery is reduced to a value approximating to the atmospheric, even though the index is in its zero position.

The Caged-Disc Type.

The caged-disk valve is a further modification of the primary knife-edged valve. It is found mainly in circle absorbers and "inhalational" vaporizers and is meant to be used in the

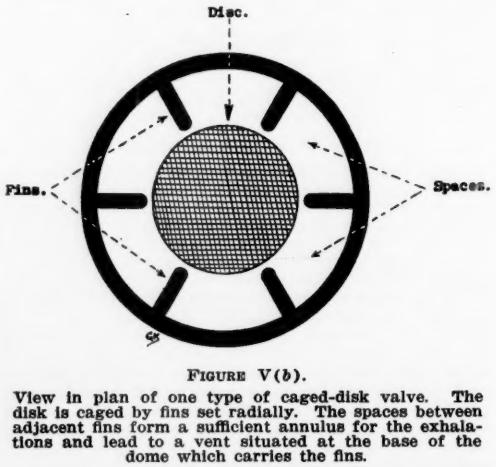

FIGURE V(*b*).
View in plan of one type of caged-disk valve. The disk is caged by fins set radially. The spaces between adjacent fins form a sufficient annulus for the exhalations and lead to a vent situated at the base of the dome which carries the fins.

horizontal position. Resort is often made to it when the design requires the vents to be placed at some distance from the seating.

The principle of the caged-disk valve s illustrated in Figure V (*a*). The seating, channels and disk do not depart from the conventional form, except that the locating-pin is now absent. Instead, displacement of the disk from its seating and into the vents is prevented by some form of cage. This plan eliminates the slight frictional resistance which occurs between a locating-pin, however well polished, and a disk. It also obviates the

slight leakage which can occur around the pin, although this is negligible if the two components form a good running fit, as they should. In an "inhalational" system, the channel open to the gases is so large that they will tend always to follow it, rather than to enter the minute gap between disk and pin. Even when pressure is applied to the gases after the valve has closed, as when a circle absorber is used for "controlled respiration", leakage will not occur; the pressure on the two surfaces of the expiratory valve-disk becomes equal as soon as the inspiratory valve has opened, and *vice versa*. The use of caged-disk valves is therefore by no means obligatory in a circle absorber.

The earliest cages consisted of two intersecting arches of wire. As these grew damp with exhaled moisture, the lifting disk was apt to adhere to them, making the valve incompetent. Further, the disk could tilt so as to wedge itself between two wires or, returning edgewise to its seating, to fall into the orifice. The later plan, therefore, was to use an annulus which limited the lift of the disk and arrested it in the horizontal plane. This annulus was carried on supports, rounded in section to give linear contact and thus reduce friction. They just touched the periphery of the disk and kept it in alignment with its seating. The gaps between these supports served as vents. The most modern type of cage is that used in the Oxford vaporizer and depicted in Figure V (*b*). It consists of a transparent dome, having radial fins which register against the periphery of the disk. These fins are rounded on their surfaces of contact and they converge towards the apex of the dome, thus preventing tilting whilst setting a limit to lift. The gaps between adjacent fins form vents of ample sectional area; these unite into a common respiratory channel at the base of the dome. In a valve of this construction, the disk does not easily adhere to the top of the dome, although it can do so if the breathing is unusually deep.

The caged-disk valve conforms to the general requirements of the modern knife-edged valve, as depicted in Figures II and III (*a*). The cage must be high enough to allow the full calculated lift to the disk. Since springs are absent, the return of the disk to its seating is due almost entirely to gravity. The valve is therefore sensitive to errors in design, especially to those which allow the disk to move laterally, to tilt or to adhere. The position of operation must be horizontal: attempts at vertical setting have not been successful. The production of a satisfactory caged-disk valve makes exacting demands upon designer and machinist alike.

The Rubber Sleeve Type.

The rubber sleeve valve, illustrated in Figure VI, is the simplest of directional valves. It consists of a sleeve of appropriate diameter, of about the thickness of a surgical rubber glove, slipped over the end of a tubular channel. This sleeve is slit longitudinally, with scissors, almost to the zone of its attachment. It will then act as a directional valve, its sensitivity depending upon its bore and its elasticity. Its slit produces two orifices, the summed sectional area of which must not fall below that of the sleeve itself or of the channel to which it is attached. It is well, however, to leave the two flaps comparatively long, since better closure ensues: they might be given, as an empirical figure, twice their minimal calculated length.

FIGURE VI.
The rubber sleeve valve.

The rubber sleeve valve may be used in any position. It was employed in the early circle absorbers, but is now unusual. It is not positive in action and its flaps may adhere, so that respiratory effort is needed to separate them. The efficiency of the valve declines as its rubber sleeve becomes hard or sticky with age. If used, it must be watched carefully and its sleeve be renewed periodically.

The Rubber Flap Type.

The rubber flap valve has a history almost coextensive with that of anæsthesia itself. Its design is illustrated in Figure VII (*a*). The flap is anchored by one end above a flange-like seating formed at the termination of a respiratory channel. In practice, the valve is usually made as a flanged sleeve, which fits closely inside the channel that is to be made directional. The sleeve ends in a plate, through which an orifice is then cut. A flange, about one-eighth of an inch in width, is left around this orifice to form a seating. In one area, the flange expands to accommodate two threaded holes. The flap is sandwiched between this expansion and a thin, narrow plate of metal. Two fine screws, traversing both plate and flap, engage with the threaded holes and serve as anchors.

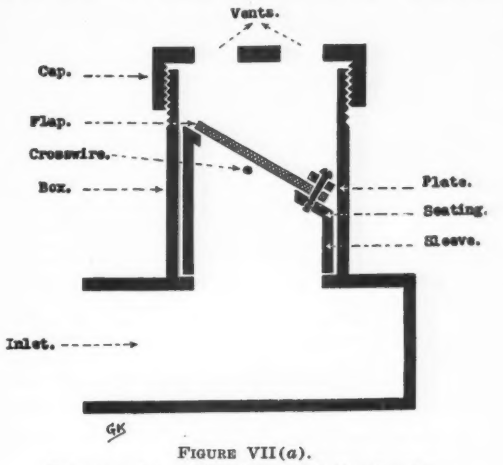

FIGURE VII(*a*).
Diagram of a rubber flap exhalational valve.

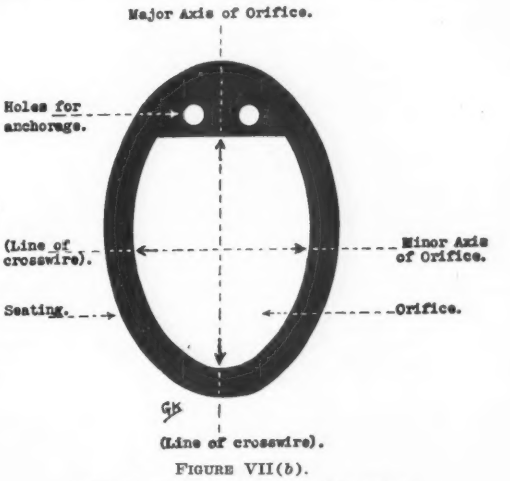

FIGURE VII(*b*).
Plan of seating of a rubber flap valve.

A valve of any design functions most efficiently if its disk or flap lies at right angles to the direction of gas-flow. In the "ideal" flap valve, the flange should lie in the cross-axis of the sleeve. This plan can be adopted only in apparatus of very wide bore, as will be explained. There are two reasons why a flap valve opposes more resistance to the breathing than does a disk valve of like bore. Firstly, the anchorage of the flap encroaches somewhat upon the circular orifice. Secondly, a lifting flap does not uncover the whole of the orifice, as does a lifting disk. Instead, it "peels off" from its free extremity, very little air escaping from beneath it in the region of its anchorage. Hence, whilst a diameter of seven-eighths of an

inch suffices for the orifice of a disk valve, a flap valve probably needs one of an inch or an inch and one-eighth. If the latter figure is accepted and allowance is made for the thickness of walls and flanges, the external diameter of an acceptable sleeve may well be an inch and three-eighths. The channel which receives this sleeve must therefore have an external diameter of about an inch and a half, which is inconveniently large.

To overcome this difficulty, it is usual to cut the sleeve at an angle to its long axis, thus increasing the length of its orifice. The latter assumes the form depicted in Figure VII (*b*), the seating being elliptical and the orifice deporting from an ellipse only by reason of the projecting anchorage. It is tempting to regard the effective area of this orifice as being approximately that of an ellipse, of which the major axis is the distance from the anchorage to the bottom flange and the minor axis the greatest distance between the two lateral flanges. This assumption would not be correct. It would ignore the fact that the pressure of the exhalations upon the flap must be resolved into an effective lifting moment normal to its surface. This correction could doubtless be made by means of the integral calculus. It would still leave uncorrected the error which arises from the fact that expired gases do not escape uniformly from beneath the flap, but rather from beneath its unattached end. The present writer cannot suggest any mathematical correction for this error, yet, without one, it seems impossible to design an "ideal" flap valve.

Resort must therefore be made to empirical methods. The writer has found that a sleeve, an inch in external diameter and seven-eighths of an inch in bore, answers well when cut at an

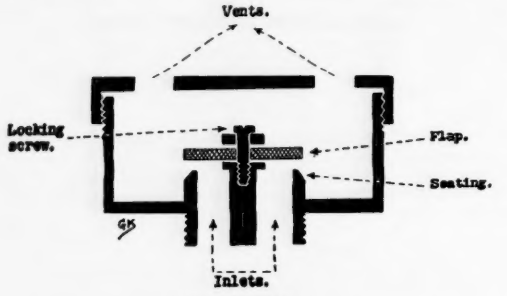

FIGURE VIII.

Diagram of a rubber flap exhalational valve, of a type often found in industrial or service respirators.

angle of 38° to its long axis. Its flange is one-eighth of an inch in width; its orifice has axes measuring, respectively, one inch and one-quarter and three-quarters of an inch. When fitted with a flap of suitably thin and elastic material, this valve seems to be reasonably "effortless". If its orifice is regarded as approximating to an ellipse, having axes as given above, its sectional area A can be computed from the following formula: $A = \text{major axis} \times \frac{\pi}{4} (\text{minor axis})$. The computation yields a figure of 0·73 square inch. How much of this area is effective seems to be incapable of calculation. It may be that "ideal" design for a flap valve is to be reached only by physical experiment, of which the possible nature will be discussed as this paper proceeds.

With further reference to the construction of the flap valve, certain criteria are to be observed. The seating should be flat. The flap should be thin and elastic, these qualities influencing the lift. It should overlap its seating by only one-sixteenth of an inch, greater overlap favouring adhesion and perhaps contact with the walls of the valve box. If the rubber is very thin, it may be drawn backwards into the orifice during deep inspiration, the valve being made incompetent. A thick flap, on the other hand, offers resistance to breathing. It is well, therefore, to use a thin flap, but to support it with wire gauze set flush with the seating. The wires must be widely separated, lest they promote adhesion or restrict the area of the orifice. In practice, even one pair of cross-wires adds materially to the competency of the valve. The plate which anchors the flap should be of minimal size. If screwed down too tightly, it may cause the flap to curl and to become incompetent.

Rubber flap valves are easily made and serve many uses. They are silent and work equally well in any position. Their efficiency declines as the flap hardens or grows sticky with age, the result being resistance, adhesion or incompetence. The flap must therefore be inspected periodically. Flaps made from plastic material are more durable than those of rubber, but are sometimes insufficiently flexible in cold weather. A drawback to all flap valves exists in the fact that the flap, if thin and sensitive, can be so displaced by forceful expiration that it may touch the top of the valve box. If this is damp with exhaled moisture, the flap may adhere to it and the valve become incompetent. No valve, whatever its design, can be trusted always to function. The checking of the valves of his apparatus should be as instinctive with the anæsthetist as is his observation of the patient's breathing.

A common sub-type of the rubber flap valve is illustrated in Figure VIII. It consists of an annular seating, desirably seven-eighths of an inch in bore, machined to a blunt knife-edge. Its flap is circular, overlapping the seating by one-sixteenth of an inch and having a central anchorage. Cross-wires are fitted flush with the seating. Expiration takes place between the periphery of the flap and the walls of the valve-box, so that a sufficient annulus must be left to render the valve effortless. Valves of this design are frequent in service and industrial respirators, since they can be produced easily and cheaply *en masse*. They are, however, often of inadequate bore. Trial samples of wide bore were made up by Dr. John Watson and the writer. They were tested by the only available methods—namely, by the senses and by manometry with water. By these crude standards, they did not seem to be superior to wide-bored disk valves or flap valves of more orthodox design.

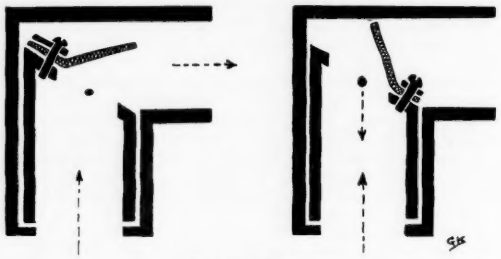

FIGURE IX.

Rubber flap valve: position of anchorage of flap. The left-hand valve would function. In the right-hand valve, the flap is anchored to the opposite pole of the orifice. Obviously, this valve would not function.

The defects most often seen in commercial flap valves are the following: (*a*) undue thickness of flap; (*b*) excessive overlap; (*c*) contact between the periphery of the flap and the valve box; (*d*) undue width of seating; (*e*) absence of cross-wires; (*f*) restriction of the orifice or of the channels leading to or from it; (*g*) unintelligent mounting, as in Figure IX, in which the flap could not lift without occluding its vent.

Criteria for the Design of Valves.

The first task which faced the newly convened Committee on Standards of our Society was to draft criteria for that commonplace appliance, the "inhalational" vaporizer. At the beginning of the problem, as at the beginning of the vaporizer, lay an inspiratory valve. The committee found itself altogether without standards which might guide the manufacturer of such a valve.

There is at present no more precise criterion of a valve than this—that, if it feels right when an experienced observer breathes through it, then it is right. The anæsthetist, being accustomed to breathing through valves of different designs and calibres, has usually a definite opinion as to whether a given sample is "effortless" or not. The accumulated experience of manufacturers and anæsthetists has resulted in certain arbitrary standards of design, many of which are cited in this paper. A valve made in conformity with them will be accepted as reasonably "effortless" by an informed observer. His assessment, however, will be subjective and not objective. What the manufacturer desires is a physical standard of performance, with which his own product can be compared. Our Society cannot yet frame such a standard. To indicate the difficulties in doing so, it is necessary to discuss the sequence of events beneath a valve disk during the respiratory cycle.

The Problem of the Lifting Valve.

It has been shown by Macintosh and Mushin that the speed of exchange is not constant throughout the respiratory cycle, but varies in the manner depicted in Figure X. The time occupied by each half of the cycle is about one second and one-half. The velocity of expiration, in a subject breathing deeply, may reach a peak of 60 litres per minute in the first half-second. It then declines progressively to zero during the ensuing period of one second. The inspiratory phase shows the same sequence of times and speeds. According to Macintosh and Mushin, the minute-volume of respiration in a subject breathing quietly is about 8 litres, but the speed of exchange may be temporarily equivalent to a volume of 25 litres per minute following the onset of expiration and of inspiration.

In the light of the foregoing, the conditions beneath the disk of an expiratory valve may be pictured in the following terms. The exhalation presumably strikes the disk as a shock-wave of high velocity and increasing force. The factors which tend to keep the disk at rest are gravity, friction and adhesion due to the presence of moisture or soda lime. As the shock-wave strikes, these static factors are overcome violently; indeed, the shock which attends the first lifting of the disk is often apparent to the observer's senses. As the disk continues to lift, the gravitational resistance becomes reinforced by that of the spring. The combined resistance is overcome by the still increasing force of the expiratory wave. At the end of a half-second, the disk may be pictured at its position of maximal lift,

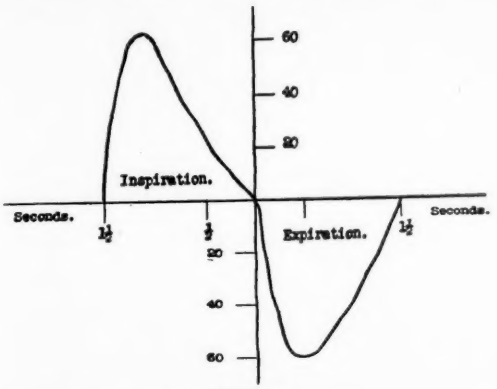

FIGURE X.

Rate of flow of gases during the respiratory cycle. Subject breathing deeply. (From "Physics for the Anæsthetist", by R. R. Macintosh and W. W. Mushin.)

with a very turbulent stream of gases sweeping from beneath it towards the vents. This turbulence probably diminishes as the force of expiration declines. At the mid-point between expiration and inspiration, the flow of gases ceases. Gravity, aided by the recoil of the spring, now acts to return the disk to its seating; the return is marked by an audible impact at the very beginning of inspiration. It is improbable that the suctional effect, which accompanies the reversal of respiratory phase, plays any significant role, since it has to act across the whole distance of lift, which is relatively great in a valve of good design.

The above description is conjectural, not having been demonstrated graphically to the writer's knowledge. Its demonstration, whilst likely to be difficult, is essential to the drafting of physical criteria for the performance of valves. The empirical standards now used by manufacturers produce valves which are clinically acceptable. There is, however, no positive information as to the point at which nonconformity begins to prove embarrassing. The manufacturer has no physical yardstick by which to judge the performance of his product.

In the search for "effortless" valves, two courses are open. The first retains the present empirical standards, but notes systematically the effects of departure from them. By methodical variation of such factors as weight of disk, calibre, overlap or tension of spring, it may be possible to subject the present empirical standards to review. The second and preferable course is to devise laboratory tests for the efficiency of valves. The difficulties in this course are such as the anæsthetist can scarcely hope to surmount without the aid of the physicist and engineer. Some of these difficulties will be presented, although no clue to their solution can be offered.

The obvious approach to the subject is to attempt to measure the back-pressures produced in different valves before their disks begin to lift. These pressures are of the order of a few millimetres of water—that is, they are relatively gross by modern standards of measurement. Unfortunately, respiration is a phasic event and its investigation must take count of the time-scale as well as of the scale of magnitudes. Dr. Watson and the writer have attempted to measure these pressures by manometry, but altogether without success. The phasic variations are so rapid that aqueous or mercurial manometers, which possess "lag", cannot cope with them. It seems unlikely that kymographic studies of the behaviour of valve disks would be any more successful; the lost motion in the levers would be a decisive drawback, even were the rotating drum able to record changes so rapid. More refined methods are therefore necessary. One such might consist in high-speed cinematography of a disk mounted in a transparent valve-box, the resulting picture being projected at low speed. A second method might involve the reflection of a ray of light from a silvered disk into a system of mirrors and its recording by photographic means. A third possible method is oscillography, which is well adapted to the graphic representation of phasic events.

The phasic nature of respiration introduces another technical difficulty. The respiratory cycle cannot be adequately represented in the laboratory by the continuous delivery of a stream of air at a predetermined volume and pressure. A closer representation would be given by the use of an air-pump of variable speed and stroke, so that normal variations in the rate and tidal volume of respiration might be imitated. Even so, this plan would ignore the fact that the speed of gaseous exchange is not constant, but varies throughout each cycle as shown in Figure X. It has been suggested by Dr. E. J. C. Rennie, Acting Professor of Engineering in the University of Melbourne, that a cam-operated pump could be devised to reproduce with some accuracy this phasic element in the respiration.

With a pump of this type, combined with oscillographic or other visual records of the behaviour of the disk, it may well be possible to frame physical criteria for valves. Many factors in design could then be subjected to systematic investigation. It is, for example, not yet known what effects result from variation in the spring-loading, sharpness of seating or calibre of existing valves, or from the reduction of turbulence in them. Neither is in possible to prescribe an optimal calibre for use in anæsthesia for children of different sizes. A child's respiration has small tidal volume, with correspondingly small velocity of flow. Whilst such respiration is probably able to lift the disk of a valve of adult's size, it is uncertain whether it can return the disk to the seating at the beginning of inspiration when the valve has adult's lift. The investigation of such problems by graphic methods might well lead to the replacement of the present empirical standards by physical ones. The problem of the lifting valve is, however, beyond the scope of the anæsthetist; it requires the specialized knowledge and resources of the physicist and the engineer. It is to enlist their collaboration, as well as to interest anæsthetists in the conditions of the problem, that this paper has been written.

Acknowledgements.

The writer is indebted to his colleague, Dr. R. H. Orton, and to Mr. H. Adams and Mr. O. Grunden, of the design department of Commonwealth Industrial Gases Equipment, Limited, for helpful comment upon the framework of this paper.

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THE SURGEON–ANÆSTHETIST RELATIONSHIP.[1]

By R. H. ORTON, M.B., B.S., D.A. (Melbourne),
Melbourne.

THE purpose of this address is to discuss the relationship that should exist between surgeons and anæsthetists and to attempt to suggest means by which the status of the anæsthetist can be improved.

[1] Retiring President's address, read at the seventh general meeting of the Australian Society of Anæsthetists (British Medical Association), Perth, August 16, 1948.

Most of us have come to realize that modern anæsthesia has become increasingly complex. With the complexities have arisen new hazards for the patient. These added risks can be justified only if they confer benefits upon the patient. I believe that the added benefits which result from these methods, when employed by skilled anæsthetists, more than outweigh the risks. But the point I wish to make is that modern anæsthesia demands a high standard of skill from those practising it. How can this high standard be realized?

Firstly, the surgeons must be made aware of the possibilities of modern anæsthetic methods, of their dangers and of the demands which they make upon the knowledge and skill of the anæsthetist. This education can best be given by the demonstration of results. But it is useless to demonstrate results unless they are good. It is the duty of the senior members of the specialty, who already enjoy the confidence of their surgeons, to acquire skill in modern technique and to convince the surgeons that it will enable them to perform more complex operations, but with less disturbance to the patient. It is the duty of these senior members to seize every opportunity offered by post-graduate lectures and surgical sessions to impress upon the younger generation of surgeons that, if they wish to attain eminence in modern surgery, they must exploit to the full the advantages that modern anæsthetic methods can offer them.

Secondly, those anæsthetists who occupy senior posts must insist that those under them who propose to employ these newer methods should have previously acquired the necessary skill and knowledge. In the past, far too many anæsthetists have light-heartedly given new and potent drugs without so much as reading the literature wrapped around the package by the manufacturer. They have set out to employ apnœic methods without the slightest knowledge of what they were doing to the physiology of their patients. As a result of these actions, many drugs and methods have suffered discredit. These unjustifiable and dangerous actions should cease, and their control is in sight when we see ahead the formation of departments of anæsthesia, having at their head directors who can control their subordinates. I saw this method at work in Auckland, where all anæsthetics administered in the public hospitals of the city were under the control of one man, and he saw to it that the anæsthetist allotted to any particular case was capable of handling it, whether he was a staff anæsthetist or a visiting one. This means that an anæsthetist is guided along his career, starting with simple methods and gradually acquiring skill in the more complex, being at all times under supervision if necessary. Here in Perth, a step has already been taken in this direction. Melbourne has similar schemes under consideration.

Thirdly, we must bring the specialty of anæsthesia into line with other specialties by requiring that, before a person can be appointed to a senior position upon an anæsthetic staff, he must possess a higher qualification in anæsthesia. In the past it was impossible to insist upon this, as higher qualifications were not available in this country. Today, with diplomas in anæsthesia being granted in two States of the Commonwealth, it is time that we reviewed the situation. One would not expect a general practitioner who had shown some interest in surgery in his practice to apply for, and be appointed to, a senior surgical position in a teaching hospital. Men have occupied such posts without higher degrees on rare occasions, but only after long apprenticeship. Why, therefore, if we wish to raise the status of the anæsthetist, should we continue to appoint to senior anæsthetic positions people who have shown but a passing interest in the subject? I trust that none will take this as a personal gibe. Many of us have acquired what skill we have in the hard way and have served our hospitals to the best of our abilities. I consider, however, that the time has passed when such a haphazard approach to anæsthesia is necessary. In the future, we should aim at placing our chosen specialty on an equal footing with any other branch of medicine.

When we have educated ourselves, educated our surgeons and raised our status to that of other specialists, then and only then can we meet our surgeons upon an equal footing. Then can the surgeon say to the casual anæsthetist who refers a patient to him, not "Would you like to give the anæsthetic?" but "Have you qualifications which entitle you to consider that you are capable of giving this anæsthetic?" This is the state of things today in Britain, where so many anæsthetists have taken the diploma of anæsthesia offered by the Conjoint Board. Surgeons demand anæsthetists with a higher qualification, and no appointment is made to a senior post without the diploma. I earnestly suggest to the younger members of this society, for their own protection, that they consider the possibility of acquiring a higher qualification. With nationalization of medicine looming on the horizon, it is well to think of the future.

In the past, the relationship between the surgeon and his anæsthetist has been too much that of master and servant, the servant merely doing the bidding of his master. It is time that this attitude vanished and the two worked together as equally important members of a team. To achieve this, the anæsthetist must know more of his own subject than does the surgeon. From this arises the question of what is the extent of the anæsthetist's subject. In the past, too much attention was focused upon the actual administration of the anæsthetic, and the surgeon felt, with considerable justification, that he himself could drop ether from a bottle just as efficiently as could his anæsthetist. The position of the latter was not improved when the surgeon found him to have little knowledge of what abuses he was inflicting upon the physiology of his patient. The surgeon felt that it was necessary for him to exercise considerable control over the administration of the anæsthetic. Now, however, the responsibility of the anæsthetist commences long before the patient reaches the operating theatre. It is his duty to assess the patient's condition and provide him with the necessary medication that will ensure a smooth approach to his surgical ordeal. During the administration, it is the duty of the anæsthetist to maintain a careful watch upon the condition of the patient and to see that all appropriate measures are taken to counter any undesirable effects. The intravenous administration of fluids should be his responsibility, and with him should rest the decision as to the volume and nature of those fluids. After the administration, the anæsthetist must decide if and when oxygen is needed and the best method of administering it in the particular case. Post-operative respiratory complications should be his responsibility, and he should be equipped to deal with any of these as they may arise. This may involve such procedures as tracheo-bronchial suction or bronchoscopy. Under these conditions, I believe the anæsthetist achieves his place in the surgical team and finds that he enjoys a status equal to that of the surgeon.

But can this be obtained under present conditions of practice? I think the answer must be "No". How, then, are we to achieve the result? I believe that the anæsthetist must be relieved of a considerable part of his financial burden if any approach to the ideal is to be made. The present system involves the anæsthetist in a great deal of unpaid work, so that in the rest of his time he is forced to fit in as many administrations as possible in order to eke out a livelihood. Two alternatives seem possible which will allow the anæsthetist to devote more time to each patient: either the fee that he receives for each administration must be considerably increased, or else he must be adequately paid for the work which he at present performs for charity. It seems to me that a little of each alternative is desirable. The scale of anæsthetic fees is out of all proportion to the amount of attention the anæsthetist should give to his patient. I deliberately say "should give", as I feel that he should devote more time than he does today. The second suggestion is that he should be paid for his work in public hospitals.

How does this scheme of payment work out in practice? I think it justifiable to relate my personal experience over the past year or so, to give an idea of what work can be done by an anæsthetist under this system. In the thoracic unit in which I work, I am employed by the hospital upon a salary basis, but have the right of private practice to the extent that I can charge fees for all private anæsthetics administered in the unit. The result is that I administer anæsthetics for approximately 250 major thoracic procedures per year, and carry out on these patients all the pre-operative and post-operative treatment which I have already enumerated. I find this work a full-time occupation, with very little spare time, and I feel that these patients are being reasonably well cared for. What would be the position if I was doing this work on a charitable basis and was required to earn my living in the time left at my disposal? The pre-operative and post-operative treatment would have to be sacrificed. A thoracic unit is, of course, an extreme example, for the post-operative attention is much greater than in general surgical cases. But the anæsthetist who deals with general surgical work would, if relieved of the burden of the honorary side of his practice, find more time to follow up his patients and attend to their needs. Recently, I investigated the pulmonary complications in one hospital and found that no patients with post-operative atelectasis had been actively treated in the past five years, except those in the thoracic unit.

Surely this is an indication that, under the honorary system, the patient is not receiving the maximum attention.

At the risk of redundancy, I should like to recapitulate my opinions. I feel that the present relationship between surgeon and anæsthetist is not entirely satisfactory. It can be improved if the status of the anæsthetist in the community is raised. In order to raise it, the anæsthetist must be prepared to place himself in the same position as the specialist in other branches of medicine. Having done this, he will find that, to do justice to his patients, he must restrict the volume of work that he does. As a corollary to this, he must receive remuneration for the service that he gives at present in an honorary capacity.

THE INTRAVENOUS USE OF PROCAINE.[1]

By I. SCHALIT,
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THE use of procaine was introduced into medicine by Einhorn in 1904 as a method of blocking painful impulses. From that time almost to the present day warning after warning has been delivered about the danger of its intravenous injection. In 1909 Bier introduced a method of intravenous injection which could be used only for operations on the extremities. A method was quoted in 1931 in which 10 millilitres of a 2% procaine solution were introduced below a tourniquet, which was not to be removed for thirty-five minutes, or the drug might reach the general circulation with possible disastrous results. For the first time in 1940 at the Mayo Clinic procaine was used intravenously to promote general analgesia, in this case for the relief of pruritus. In 1943 Gordon in Canada used it for the relief of pain in the dressings of painful burns. In 1945 Allen of New York described its use for the relief of the pains of labour and of delivery, and in 1947 Delorme in a letter to the *British Medical Journal* described its use as a substitute for morphine.

Pharmacology.

It has been demonstrated that the barbiturates are the most satisfactory antidotes for the toxic action of the local analgesics. McIntyre demonstrated that sodium barbital considerably increases the tolerance of dogs for most local analgesics, and suggests that it also acts in the prevention of convulsions and hyperpyrexia. "Nembutal" or "Pentothal", or both together, have been administered prior to the anæsthetic in most of the cases to be described, although it may be well argued that it would have been advisable to keep this procaine antidote in reserve.

Mode of Action.

What is the action of procaine injected intravenously? When injected locally the salt is hydrolysed by the alkaline tissue fluids with the production of an alkaloid base, which in turn is taken up by the lipoids of the nerve tissue, depression being caused. According to Allen, the theory appears valid that procaine, circulating in low concentration after an intravenous injection, does not produce local analgesia in normal tissues; but in regions of injury, pain, inflammation or œdema, the increased capillary permeability allows the procaine to diffuse into the tissues and anæsthetize the nerve endings there.

What is the central effect of procaine given intravenously? Clinically I have observed nothing obvious, either in association with or without general anæsthesia. Allen, however, deliberately giving a strong infusion, describes dizziness, the patient feeling far away, or the appearance of convulsions, which rapidly disappear when the infusion is stopped.

Skin Test.

Approximately half an hour prior to the administration of the anæsthetic an intradermal weal is made with 0·5 millilitre of 1% procaine solution and the reaction noted prior to the intravenous injection. So far I have encountered only one case of doubtful sensitivity. This test would appear to be desirable, at least until the method has been tried in a far greater number of cases than I offer you. People who work extensively with local analgesics, as for example dentists, are more likely to become sensitized to this substance. In this class the incidence is high, and I know three dentists who are sensitive to it. In order to take advantage of the local analgesic effects of procaine, I made the test dose at the exact site through which it was proposed to insert the intravenous needle.

The Anæsthetic.

This afternoon I want to offer you my observations on 112 cases—a very small number. Procaine was administered intravenously in two ways—(i) combined with general anæsthesia and (ii) as the sole drug.

When procaine was combined with general anæsthesia, the method used was to give the procaine by the drip method, in conjunction with a small dose of "Pentothal" and with comparatively light nitrous oxide and oxygen anæsthesia, except in the case of upper abdominal operations, in which I substituted cyclopropane for nitrous oxide and oxygen. When I first began, the percentage of the procaine was 0·1 and the solution was injected by syringe. Later the syringe was changed for a drip administration, the concentration was raised to 0·5%, and the amount and the rate of flow were much increased. Finally the rate of flow aimed at was in the region of 60 drops per minute.

"Pentothal" was given as a sleeping dose and as a protection against the possibility of convulsions. The amount rarely exceeded five millilitres of a 5% solution, and that amount or a little less was the usual dose. The aim with nitrous oxide and oxygen was rather ambitious, and was to "run" the patient on 33% oxygen; this sometimes succeeded, but usually the concentration finished up with an average of about 25%. I learnt from experience that until the incision had been made and the wound open for several minutes—time enough to allow an exudation of procaine solution—into the area of operation nitrous oxide and oxygen were usually insufficient to hold the patient with this high percentage of oxygen, and enough cyclopropane was added to free the patient from painful stimuli. Afterwards there was a return to nitrous oxide and oxygen and on no occasion was positive pressure used with this. Cyclopropane was used mostly for upper abdominal operations, the average proportion being about 16% cyclopropane once the patient's condition had become stabilized.

Prior to the skin incision at least 50 millilitres of the 0·5% solution were allowed to run into the vein, the first few millilitres being run in very slowly while a watch was kept for any untoward reaction. Painful stimuli, which were registered by either respiratory change or movement of an extremity, were alleviated usually, but not always, by an increase in the rate of flow of procaine solution. The response when it took place was fairly rapid and took about three times the duration of a supplementary injection of "Pentothal" to act. More recently I have changed from this, and find that in the event of an arm or leg movement it is more effective and certain to add a small amount of cyclopropane. The rate of flow was also increased when a painful stimulus was anticipated, such as the opening of the peritoneum, or when extra muscular relaxation was required.

In order to secure a satisfactory level of procaine I allowed the drip to run at a rate that would keep the patient relaxed if that was necessary; for example, when 0·5% solution with "Pentothal", nitrous oxide and oxygen was used, this proved to be between 80 and 130 drops per minute. For extraabdominal procedures the rate was at that level which just prevented movement—about 40 to 80 drops per minute. These two signs—relaxation and absence of movements—are the only guides I have been able to find to indicate the level of anæsthesia at which to keep the patient. They have proved satisfactory in practice.

When procaine given intravenously was used as the sole drug, not in conjunction with general anæsthesia, the rate of flow of the procaine solution was just as fast as would give the patient relief from pain. This proved to be about 60 to 90 drops per minute with a concentration of 0·1%.

After a few trials at intermittent injection with a syringe the method was abandoned, as it proved practically less efficient than the continuous drip method.

Concentration, Amount and Rate of Injection.

Concentration.

The most dilute solution used so far was 0·05% for post-operative pain. My very first injection was with the concentration of 0·1%—a concentration which I have used

[1] Read at the seventh general meeting of the Australian Society of Anæsthetists (British Medical Association), Perth, August 16, 1948.

many times since. From this concentration I gradually worked up to 0·5%, which is used as a routine in all cases in which procaine is combined with general anæsthesia. In two cases I tried a 1% solution; in the first it was successful in combination with nitrous oxide and oxygen; in the other, to which I will refer later, the patient became pulseless. Then there was the patient to whom I gave a solution of 2% in error. It was given at the period when the highest concentration that I had administered was 0·1%—twenty times the concentration, and at least four times the speed that I had ever used previously, and yet the patient suffered no ill-effects. Admittedly this was an error; but from it I learnt some of the possibilities of the intravenous use of procaine. However, I still do not recommend the procedure. The case was as follows.

Mr. H.C. was a healthy young man, aged twenty-eight years, who was to have an operation upon a left inguinal hernia. Owing to faulty administration on my part, there were two syringes on the same tray both containing 20 millilitres of solution. One contained 2·5% "Pentothal" solution and the other a 2% solution of procaine in 1,200,000 strength adrenaline, which I had prepared for injection of an ulnar nerve. The anæsthetic was proceeded with, when, after 15 millilitres had been injected over a period of approximately the same number of seconds, I glanced at the tray. There was the "Pentothal" syringe! At that moment the patient started to complain, and it is questionable who felt worse, the patient or myself. The patient complained of a thumping heart and a thumping headache—the obvious effects of an intravenous injection of adrenaline. This lasted for about twenty seconds, and after this there were no other effects that could be recorded. He felt no sleepier, noticed no symptoms of numbness or "pins and needles". There was no obvious change in colour or respiration. His blood pressure was not recorded. About three minutes after this happening, eight millilitres of a 2·5% solution of "Pentothal" were injected and the anæsthetic was continued with nitrous oxide and 30% oxygen. Tension on the sac produced no effect on the patient or change in respiratory rhythm. Anæsthesia could be described as satisfactory. The operation lasted forty minutes. At the completion of the operation the patient quickly recovered consciousness, and on close questioning showed no untoward symptoms. He had, as I learnt to expect later, far less pain than usual in the operation area.

Amount.

With the 0·1% solution for post-operative pain, the greatest volume of fluid has been 1000 millilitres—that is, one gramme—given over a period of a little over six hours. When the 0·5% solution was used, the greatest volume was 980 millilitres (4·9 grammes) over a period of two and three-quarter hours. The patient was to undergo a Millin's prostatectomy, and nitrous oxide and oxygen anæsthesia was used. When a 75% concentration of nitrous oxide was used, the patient moved his legs on about five or six occasions; in this case the movement could not be controlled with the "drip" alone or with the nitrous oxide and oxygen, and it was necessary to add cyclopropane. The condition of the patient in spite of this amount of procaine was most satisfactory.

Rate.

The rate of flow at which I aimed was 60 drops per minute, or approximately two and three-quarter millilitres per minute. However, there was no hesitation in running the drip at a much faster rate than this, and on occasions it has been run as a stream.

Sensation.

As might be expected, there appears to be no obvious dulling of superficial skin sensation; here I refer to unbroken skin only. With the exception of one case, those patients I questioned would admit no loss of sensation. The majority of tests for reactions were made on those patients who were receiving a 0·1% solution; 0·5% for the purpose of testing reactions was used on only one occasion. When the skin was not intact—as, for example, in second and third degree burns—an intravenous infusion provided a painless area for working. Case I, described later, was a typical example.

I had only one case of generalized pruritus resulting from jaundice. This patient's irritation was relieved by the injection of a 0·1% solution, and he received a total of 500 millilitres—that is, 0·5 gramme.

Under general anæsthesia a painful response to any incision was usually elicited unless precautions were taken to deepen the anæsthetic, but as a contrast the suturing of a wound needed less depth of anæsthesia than usual. This appears to bear out Allen's theory of exudation of procaine into traumatized areas and not into healthy ones.

Muscular System.

With regard to the muscular system, the effect is what may be expected when one thinks in terms of local analgesia. Here the sensory fibres are first affected and then finally the motor fibres. In the intravenous injection there was no muscular response whatever when the procaine was not used in conjunction with general anæsthesia. Here the concentration of 0·1% was so low and the rate of infusion so slow that further experience indicated that no muscular response could be expected. In my own cases there was never a complaint of weakness either general or in any particular extremity.

For example, after gastro-enterostomy, Mr. S.P. was given 1000 millilitres of 0·1% procaine solution for relief of pain in the area of his wound. The infusion lasted over a period of about six hours. Questioned five hours after the commencement, he stated that all his limbs moved freely and that there was no feeling of heaviness about them.

When procaine was used intravenously in combination with general anæsthesia—for example, with a small dose of "Pentothal" followed by nitrous oxide and oxygen—the muscular effects could be divided into three types, the reaction depending on the concentration and the speed with which the infusion was given. (i) When 0·5% procaine solution was administered at slow speed (for example, 40 drops per minute) there was no change in the state of the voluntary muscles. (ii) If the rate was stepped up to 60 to 100 drops per minute there was moderate relaxation, of a degree satisfactory for the performance of a hernia repair. (iii) In order to obtain enough relaxation for a lower abdominal operation such as an appendicectomy, the average speed needed to be higher—for example, 80 to 130 drops per minute.

An example of this is the case of Mr. T.G., a healthy young man of twenty-three years, weighing about ten and a half stone. He received 350 millilitres of a 0·5% procaine solution (1·75 grammes) over a period of thirty-five minutes, in combination with nitrous oxide and oxygen and without a previous injection of "Pentothal". The relaxation was satisfactory, but here an interesting feature was observed: there was relaxation in the area of the operation, while in the remainder of the abdomen only a small amount of relaxation was apparent.

This almost selective action appears to bear out the theory that procaine solution is diffused in the areas of injury and pain. I have termed this "selective relaxation". Incidentally, during the course of an anæsthetic for this type of case, arm and leg movements may occur, which usually but not always disappear when the rate of flow of the solution is increased.

For upper abdominal operations such as cholecystectomies, the rate of flow of the 0·5% solution varied from 40 to 80 drops per minute, as here cyclopropane was the chief anæsthetic agent.

Mrs. D.P., a healthy woman, aged forty-four years, had her gall-bladder removed. On arrival in the anæsthetic room she was awake and talking, although she had received three grains of "Nembutal" and one-quarter of a grain of morphine pre-operatively. She was given not "Pentothal", but cyclopropane and oxygen. During the opening of her peritoneum the rate of flow was 55 drops per minute and the proportion of cyclopropane to oxygen was 100 to 400 per minute. Relaxation was satisfactory, and it remained so from this stage to the end of the operation, the rate of drip never going above 55 and finally dropping to 40 per minute. The cyclopropane-oxygen proportion varied only slightly around the previously mentioned figure. The total volume of procaine solution used was 190 millilitres over a period of one and a quarter hours. The relaxation of this particular patient was all that could be asked by any surgeon.

A comment that I made during this case is given for what it is worth: with pressure on the bag, the chest feels "curare like".

The total number of abdominal operations performed under the types of anæsthesia described was 46, and I would agree with this audience that it is a very small number on which to give an opinion.

Relaxation remained just as long as the infusion was continued. It ceased in a short space of time after the flow was discontinued.

Brief spasms of convulsions as described by Allen were not encountered.

Respiration.

When a small volume of the solution had been given, there were no obvious changes in the rate or type of respiration under general anæsthesia which could be solely attributable to the procaine. With a concentration of 0·5% and with a larger volume there was occasionally some respiratory depression, which never at any time went on to complete cessation of respiration. Very painful stimuli when a small volume of solution was used produced the same change as would occur in light anæsthesia, while with a greater volume and 0·5% concentration, the stimulus produced little or no change.

Post-operatively when pain interfered with the free expansion of the lungs, an infusion of 0·1% gave the patient enough ease to facilitate his cooperating in breathing exercises.

Cardio-Vascular System.

A 0·1% solution flowing at a slow rate appeared to cause no change in the blood pressure readings. When a 0·5% solution

was used in conjunction with a general anæsthetic, such as a small dose of "Pentothal", cyclopropane, or nitrous oxide and oxygen, a certain amount of confusion resulted, as the influence of these substances also had a bearing on the final reading.

However, examination of a typical chart showed that on injection there was a 10 to 15 millimetres rise in both systolic and diastolic pressures which took place within the first ten minutes. This was followed within five minutes by a fall to approximately the original pressure. Later the systolic pressure fell slightly, the diastolic pressure remaining fairly constant.

The pulse rate remained reasonably constant once the patient had settled down. Arrhythmias were observed in association with cyclopropane, but the impression was that they were far less in number than could be expected with this particular anæsthetic, an impression confirmed by the findings of Fraser of Canada.

Hæmorrhage from the area of a wound appeared to be uninfluenced. One of the signs observed when procaine was used without general anæsthesia was flushing about the head and neck.

Eyes.

The eye movements and the pupils appear to be entirely uninfluenced by the intravenous use of procaine. When procaine is administered with a general anæsthetic, the movement of the eye appears to be characteristic of that particular anæsthetic. Reactions to both light and accommodation showed no variation from the normal.

Cough.

What was the influence of the intravenous use of procaine on the cough reflex? The routine that I used in nine cases was to induce anæsthesia with a small dose of "Pentothal" followed by a deliberate overdose of ether, great enough to cause a spasm of coughing. At this point procaine was injected. I started with a concentration of 0·1%, injecting 10 millilitres, and in the first case there appeared to be a definite reduction in the irritating effects of ether. In seven further cases the procedure was tried, and failure was met with on each occasion. Later an attempt was made in one case to see if there was any effect on the coughing produced by bronchoscopy. This patient's throat had previously been sprayed with 10% cocaine solution, and on passage of the bronchoscope while coughing was occurring seven millilitres of 0·5% procaine solution were injected. Again there was no obvious relief. However, on the occasions when an intratracheal tube was *in situ* I did observe that there was an obvious reduction in the irritability of the trachea. Under the very light anæsthesia which was used in all these cases, the movement of the tube within the trachea produced little or no reaction. In several cases, in which the patient was blinking his eyes and talking within the space of two to three minutes, the removal of the tube did not produce a spasm of coughing or irritation.

Reports of Cases.

A few selected case records will be summarized briefly as provisional illustrations of the various methods employed.

CASE I.—A simple procaine infusion (0·5%) was used during the cleansing and dressing of second and third degree burns of the left leg from just below the knee to the toes.

Mr. A.M., a healthy labourer, aged thirty-five years, weighed about twelve stone. A pre-operative injection of one-quarter of a grain of morphine and 1/100 grain of atropine was given. Prior to operation the patient was wide awake.

The operation commenced and the leg was gently cleansed with ether soap. The patient immediately complained of pain, at which point five millilitres of 0·5% procaine solution were injected. Within a few seconds he stated that his pain was gone. At five minutes, 10 millilitres were injected. The patient stated that the burnt leg felt numb, but the other felt no different.

At thirteen minutes he complained of slight pain, which was relieved by an injection of five millilitres. A couple of minutes later he said he had "a tickling sensation" in his leg, but no pain. At seventeen minutes the patient remarked: "I can feel them working, but there's no pain." At twenty minutes a further five millilitres were given, and the operation concluded a few minutes after this. A total of 35 millilitres of 0·5% solution (1·75 grammes) was given over a period of twenty-five minutes.

In this case I noted on two occasions an interval of almost exactly seven minutes between the injection and the first complaint of pain.

CASE II.—A simple procaine infusion was given for the post-operative relief of pain. Mr. S.W. had had a posterior gastro-enterostomy performed the previous day under "Pentothal", cyclopropane and oxygen anæsthesia with curare. Nineteen hours after operation the patient complained of most severe abdominal pain, which had been little relieved by the administration of a quarter of a grain of morphine three hours previously. Five millilitres of 0·5% procaine solution were given intravenously, and the pain was relieved almost immediately. This was followed by a 0·1% solution given by the drip method, 500 millilitres of this solution (0·5 gramme) being administered over a period of about three hours; the rate of flow was 60 drops per minute. Prior to the injection, the patient's description of his pain had been that in the area of his wound it was "very tight and aching". After the injection he said he felt easier. However, his pain was not entirely relieved.

CASE III.—In this case a 0·5% procaine infusion was combined with nitrous oxide and oxygen anæsthesia. Mr. N.J. was a healthy elderly man, aged sixty-two years, who underwent drilling of an old fractured tibia. Premedication consisted of one-quarter of a grain of morphine and 1/150 grain of hyoscine. He arrived in the anæsthetic room talking cheerfully. Anæsthesia was begun at 10 a.m. and the operation commenced a few minutes later, by which time the patient had received 20 millilitres of procaine solution. The rate of flow was 45 drops per minute and the percentage of nitrous oxide 66. When the incision was made the patient moved; cyclopropane was added for a couple of minutes, and the rate of flow was increased to 60 drops per minute. On this the patient settled down. At 10.15 a.m. the rate was increased to 80 drops per minute, and the gas percentage had been returned to 66. Twenty minutes later the operation was concluded. A total of 125 millilitres (0·625 gramme) was administered over a period of thirty-five minutes.

CASE IV.—A 0·5% procaine infusion was combined with nitrous oxide and oxygen and a small amount of cyclopropane for thyreoidectomy. Prior to anæsthesia the patient, Mrs. L.C., was given three grains of "Nembutal" followed by one-quarter of a grain of morphine and 1/150 grain of hyoscine. She came into the anæsthetic room sleepy but not unconscious. Four millilitres of 5% "Pentothal" solution were injected, and the administration of nitrous oxide and oxygen followed. An attempt at blind intubation was a failure after 40 millilitres of procaine solution had been injected. Cyclopropane was added in order to facilitate intubation under direct vision; it was not used again during the remainder of the operation. After this stage the patient was controlled on 70% nitrous oxide with the drip infusion flowing at an average rate of 80 drops per minute. The duration of the operation was one hour twenty minutes, and the amount of procaine solution used was 300 millilitres (1·5 grammes). Her condition remained satisfactory throughout. At the end of the operation the patient was talking intelligently while still on the operating table. She was lying quietly and on being questioned she said that she had no pain. She experienced no nausea or vomiting, and she received no sedative until twelve hours after operation.

CASE V.—A 0·5% procaine infusion combined with "Pentothal", nitrous oxide and oxygen was used for a herniorrhaphy. Mr. R.C. was a healthy man, aged twenty-six years, and weighing 12·5 stone. Prior to operation he was given "Nembutal" (three grains) two hours before operation, one-quarter of a grain of morphine and 1/100 grain of atropine one hour later. He stated that he did not feel sleepy. The induction of anæsthesia commenced at 10 a.m., when six millilitres of 5% "Pentothal" solution were injected; the administration of 80% nitrous oxide and 20% oxygen at atmospheric pressure followed. The rate of flow of the procaine solution was 90 drops per minute. The operation commenced at 10.15 with the same concentration of nitrous oxide, but the procaine drip was increased to about 180 drops per minute, as the patient moved his leg at the time of incision. At 10.30 the rate of drip was down to 120 per minute; a comment that I wrote at this time—and I think confirmed subsequently—was that once the original incision has been made the patient appears to need less procaine. The ratio of nitrous oxide to oxygen was reduced to 75 : 25. Tension on the sac produced no alteration in respiration. At 10.35 tension on the sac resulted in a minor leg movement and an alteration in respiration, again controlled by an increase in the rate of flow for a short period to 180 per minute. After this there was nothing unusual to report, the rate of flow remaining at 120 per minute and the nitrous oxide and oxygen still at the same ratio of 75 : 25. The operation concluded at 11.15, and during the hour and a quarter, 500 millilitres of 0·5% solution (2·5 grammes) were used. With the exception of the leg movement, anæsthesia could be described as satisfactory.

CASE VI.—A 0·5% procaine infusion was combined with "Pentothal", nitrous oxide and oxygen for appendicectomy. Mr. T.G., a healthy young man, aged twenty-two years, weighed about nine and a half stone. Premedication consisted of one-quarter of a grain of morphine and 1/100 grain of atropine, and after this he was sleepy, but talked intelligently. Four millilitres of a 5% solution of "Pentothal" were given, and the administration of nitrous oxide and oxygen followed, and after about 50 millilitres of procaine solution had run in, the operation commenced with the proportion of nitrous oxide at 80%. The nitrous oxide proportion remained at this level throughout the whole anæsthetic without the use of positive pressure. Prior to the opening and closing of the abdomen the solution was run in as a stream. Relaxation was satisfactory, and in this case the muscles showed what I have described as selective relaxation. While the rest of the abdomen was hard, the immediate area of the McBurney incision was relaxed. The patient awoke on the operating table immediately after the conclusion of the operation. There was no struggling, but the patient lay quietly and talked. He was nauseated for a few seconds, but did not vomit. He complained of no pain in spite of a leading question to that effect. In this case 350 millilitres of solution (1·75 grammes) were used in a period of forty minutes.

CASE VII.—A 0·5% procaine infusion was used combined with nitrous oxide, oxygen and a small amount of cyclopropane for a Millin's prostatectomy. Mr. R.C. was a man, aged sixty-two years, in fairly good condition. He arrived in the anæsthetic room in a sleepy condition, having received three grains of "Nembutal" and one-quarter grain of morphine. He was given 980 millilitres of 0·5% solution of procaine over a period of two hours forty minutes. Throughout this case the relaxation satisfied the surgeon, but on about five or six occasions the patient moved both his arms and legs and this could not be controlled by either increasing the flow of procaine solution or increasing the proportion of nitrous oxide to oxygen. On each occasion cyclopropane had to be added. Twenty minutes after the end of the operation the patient was awake and talking. He said he felt very little pain. Because of the movements of the extremities anæsthesia could not be described as satisfactory.

CASE VIII.—A 0·5% procaine infusion was combined with cyclopropane and oxygen anæsthesia for gastro-enterostomy. Mr. R.S., a man, aged sixty-five years, in fairly good condition, was suffering from carcinoma of the stomach. With premedication of three grains of "Nembutal" and one-quarter of a grain of morphine he arrived in the anæsthetic room sleepy but talking. He was given 500 millilitres of a 0·5% procaine solution over a period of one and three-quarter hours. His condition remained satisfactory throughout. On two occasions there was a comment from the surgeon that

the recti were a little tense, and this was relieved by an injection of 10 millilitres of 1% procaine solution on each occasion. The patient was awake and talking ten minutes after the conclusion of the operation. He said he had some pain in his stomach, but it was not worrying him. Morphine (one-quarter of a grain) was not given until three and a quarter hours after the operation. During this period the patient appeared to be reasonably comfortable doing breathing exercises on instruction.

CASE IX.—A 0·5% procaine infusion was combined with cyclopropane and oxygen anæsthesia for cholecystectomy and choledochostomy. Mrs. M.S. was a very fat, healthy woman, aged about fifty years. She was given 340 millilitres of procaine solution over a period of two hours ten minutes. The rate of flow varied between 40 and 50 drops per minute. The ratio of cyclopropane to oxygen was between 100 and 150 to 500. Relaxation was adequate throughout and could be compared most favourably with that produced by curare. Positive pressure on the chest through the rebreathing bag gave the same sensation that one gets with a relaxed patient under curare. Anæsthesia was satisfactory.

CASE X.—A simple infusion of 0·5% procaine solution was given; this case was purely experimental. The subject who received the procaine was myself, the injection being given by Dr. R. Rutherford. Perhaps you will forgive me for going into more detail than in the previous cases that I have mentioned. Prior to the injection my blood pressure was 150 millimetres of mercury, systolic, and 110 millimetres, diastolic, and my pulse rate 72 per minute. The first millilitre of procaine was given over a period of thirty seconds. There was no reaction.

At the end of two minutes, four millilitres had been given. There was no loss of sensation to pin prick and no weakness in either leg; but I complained of feeling very flushed about the face. The systolic blood pressure rose to 170 millimetres of mercury and the diastolic pressure remained at 110 millimetres. The pulse rate was still 72 per minute. At four minutes I had received seven millilitres. There was no muscle weakness, no loss to pin prick, no loss to cotton wool; the feeling of heat about my face increased. Ability to read newsprint was normal. The systolic blood pressure returned to 150 millimetres of mercury, the diastolic pressure fell to 100 millimetres of mercury, and the pulse rate was still constant.

At five minutes I had received a total of 10 millilitres; there was no obvious change to report.

At six minutes two millilitres were injected quickly. No change was observed in muscles, sensation or face.

At eight minutes three millilitres were injected quickly. The systolic blood pressure rose to 160 millimetres of mercury and the diastolic to 110 millimetres and the pulse rate dropped to 66 per minute; otherwise there was no change.

At ten minutes four millilitres were given quickly. The systolic blood pressure was 155 millimetres of mercury and the diastolic pressure 110 millimetres; the pulse rate was 70 per minute. No change was observed in the reaction to pin prick or leg movements. Eye movements and reaction to light were normal, and ability to read newsprint was normal.

At twelve minutes six millilitres were given rapidly. There was no change to report, except in the blood pressure, which showed its only rise on diastole to 115 millimetres of mercury. The pulse rate was 68 per minute.

At thirteen minutes four millilitres were given rapidly. Burning of the face was marked, and the temperature was 98·2° F.

At fourteen minutes 10 millilitres were given rapidly. For the first time I noticed slight dulling to pin prick and to a scratch. Muscle movements were normal. Reaction to cotton wool was not tried. Eye movements were normal, and reading was normal.

At sixteen minutes eight millilitres were given rapidly. The reaction was the same as two minutes earlier.

During sixteen minutes I had received a total of 50 millilitres of 0·5% solution (250 milligrammes), and during the last four minutes of the injection the total was 28 millilitres.

One minute after the conclusion of the injection I stood up. My feeling then was one of slight malaise. There was no giddiness. My hands showed no tremor. I could stand on one leg with eyes closed and hands extended forward. Ten minutes afterwards I picked up a nitrous oxide cylinder weighing approximately 18·5 pounds; it did not feel heavier than usual. The feeling of malaise lasted for about thirty minutes, after which time there were no symptoms. During this period, however, I was informed that I was talking with a slightly slurred speech, a fact that I had not noticed myself.

Special Cases.

There were two cases perhaps worth mentioning in which the injection was a complete failure.

Mr. L.W. had suffered from trigeminal neuralgia for the last five years. Fifteen millilitres of 0·5% solution (7·5 milligrammes) were injected over a period of sixty seconds. The effect on his pain was nil, and this was confirmed by the patient in no uncertain fashion. Then there was Mrs. N.R., who had been in bed for twenty-eight days with *angina pectoris*. Five millilitres of 0·5% solution were injected over a period of 30 seconds and the patient stated that she had slight relief. Five minutes later 10 millilitres of 0·5% solution were injected over thirty seconds, and again she said there was slight relief. On getting her out of bed she complained bitterly, and stated that there was not the slightest change in her condition.

I have had experience of only three obstetric cases. In the first two, injection of about 30 millilitres of a 0·1% solution over a period of about thirty minutes did not give any relief at all. After reading Allen's article a couple of years later, I learnt that it was not surprising. I have given an adequate dose in only one case of labour.

Mrs. R.S. was a *primipara*, aged twenty-five years. A 0·5% infusion was given about half an hour after the commencement of the second stage of labour. The rate of flow was 60 drops per minute. This stage lasted about three hours, but unfortunately I ran out of solution after about two hours. The patient had received 1·6 grammes. During this period, however, the patient appeared to be having quite powerful uterine contractions with far less pain, and this point was agreed upon by both the sister in charge and the patient herself.

Mrs. N.W., a very "poor risk", aged sixty-eight years, was having a choledocho-jejunostomy performed under "Pentothal", cyclopropane and oxygen anæsthesia with curare. Because of her condition a blood transfusion was being given. After the operation had been in progress for one hour, the blood transfusion, which had been flowing at about 100 drops per minute, slowed down to 40 drops per minute. I could not increase its speed past that figure. The vein felt hard and tense. Ten millilitres of 0·5% procaine solution were injected into the lumen of the tube and the rate immediately increased to 170 drops per minute. Fifteen minutes later the rate had dropped to 88 drops per minute, and ten minutes later to 54 drops per minute. At twenty-five minutes I injected 10 millilitres of saline, and during the next ten minutes the rate stayed approximately around 54 per minute. I again injected 10 millilitres of procaine solution, and the rate rose to 88 drops per minute and ten minutes after that to 102 drops per minute. At the conclusion of operation she was returned to the ward, receiving a 0·1% procaine solution mixed with the blood, when the drip was capable of flowing as a stream.

A blood transfusion during a pneumonectomy behaved in the same way.

There were eight other cases in which 0·1% procaine solution was included in a blood transfusion, and in those the fluid was capable of flowing as a steadier stream than usual. However, with nine blood transfusions being given in the wards, when the drip was slowing down the rate of flow on each occasion could be accelerated by the injection of a few millilitres of 0·5% procaine solution into the tube.

I offer you the cases of *angina pectoris* and trigeminal neuralgia, not because I think anything has been achieved in them, but because I think they may be of passing interest. But in the blood transfusion case there appears to be something worth while.

Post-Operative Pain.

Post-operative pain has been considered from two aspects: (i) the amount of pain experienced post-operatively by those patients who received procaine intravenously as part of their anæsthetic; and (ii) the result when the drug was deliberately administered by the drip method for the relief of pain. As nitrous oxide and oxygen with or without cyclopropane and with or without a very small dose of "Pentothal" was the anæsthetic agent used mostly in conjunction with procaine, the patients were for the most part conscious and talking intelligently even before they had left the operating theatre. Nearly all stated that they felt no pain in this immediate post-operative period. This freedom lasted over a time varying from about one to six hours. The advantage of this from the point of view of a sister in charge of a busy ward needs no emphasis, and the question "What did you give him?" was asked spontaneously by the nurses on more than one occasion.

Procaine was administered in 15 cases as a substitute for morphine, as described by Delorme. His concentration was 0·2%. My routine procedure was to give 20 millilitres of 0·5% solution as an initial dose; this was followed by 500 or 1000 millilitres of a 0·1% solution. It was unusual to hear the patient say that he had entire relief, which was obtained in only three cases. All patients, however, experienced some relief.

As an example, Mr. R.S. had a transthoracic vagotomy performed under "Pentothal", cyclopropane and oxygen anæsthesia with curare. Sixteen hours after operation he was complaining of pain unrelieved by one-quarter of a grain of morphine administered one and a half hours previously. Administration of a 0·1% solution of procaine by the drip method was started immediately, 10 millilitres of 0·5% solution being given as an initial dose. Within less than one minute the patient stated that he now felt much easier and could move his head and shoulders without fear of pain. He had had a pleuritic type of pain prior to this stage, and when questioned his own words were: "I can now get much more wind into my lungs." However, as in most cases his pain was not entirely relieved.

The advantages of procaine used in this way, added to the relief of pain, are that there is no observable respiratory depression, and the patient is able to expand his lungs and cooperate in carrying out post-operative breathing exercises. Another point worth mentioning is that patients who have severe pain after operation are more often that not those who are in need of fluids. Usually, but not always, enough relief from pain is afforded to allow the patient to fall asleep.

Advantages.

To sum up the advantages of procaine given intravenously, it appears to be a non-toxic drug, and one of the more important points of its properties is that unpleasant after-effects are almost non-existent. No single case of vomiting or even nausea has been observed in any case in which a general anæsthetic

was not given. There were occasional cases of vomiting when procaine given intravenously was combined with an inhalational anæsthetic, but they were no more in number than could be expected with that particular type of anæsthetic.

Procaine given intravenously gives muscular relaxation; this is seen to best advantage when procaine is combined with the relaxing effects of cyclopropane. It was never tried with ether, with the exception of an attempt to relieve coughing. Freedom from pain in the immediate post-operative period is another advantage, and as a result of this the patient is cooperative, and not, as sometimes occurs, irrational, throwing himself around the bed. This in itself makes the nursing in this stage much easier. The quick return to consciousness following the combination of procaine given intravenously with a quickly excreted general anæsthetic allows for breathing exercises at an early stage. At this stage, if the drip administration is continued because of interference with breathing resulting from the pain of an upper abdominal or chest operation, the expansion of the lungs is made much easier and is done with far greater efficiency. Earlier ambulation, as compared with the same type of patient following an ether anæsthetic, can be allowed, and quite a few of the hernia patients in my hospital have been allowed out of bed on the same day as the operation.

The adequate treatment of dehydration is catered for with the incidental giving of fluids.

The rapid excretion or destruction of the drug should make for safety.

Disadvantages.

Of the disadvantages of the method, the most important of all is that its complete safety has not been proved. No late sequelæ have been observed, although the possibility of their existence has not been eliminated.

It was hoped that nitrous oxide and oxygen anæsthesia would have been adequate for all cases including all types of abdominal procedures; but this hope did not materialize with the use of a 0·5% solution. Although no case of convulsions occurred, the possibility of their occurrence was never overlooked.

Safety.

In the doses, concentration and rate of administration used so far, procaine appears to be a safe drug, and only one exception has been encountered. No case of convulsions has been noted, nor has there been one in which any premonitory signs appeared. The small dose of "Pentothal" or "Nembutal", or both, at the start may afford protection; it would certainly be given in conjunction with the stopping of the infusion on their appearance. The exception referred to was the case of a male patient to undergo cystoscopy, to whom I decided to give a 1% solution without the addition of a general anæsthetic. Twelve millilitres, were given in about one and a half minutes and the cystoscope was inserted. The patient's facial expression registered only a minor amount of pain. However, his pulse became feeble and just palpable over a period of about thirty seconds, after which he completely recovered. He had shown no reaction to the test dose.

RELAXING AGENTS IN ANÆSTHESIA.[1]

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APART from spinal and exceptionally good regional anæsthesia, as employed in their limited fields of utility, deep general anæsthesia has until lately been required for the production of adequate muscular relaxation during surgical operations. For many years ether and chloroform satisfactorily met this demand, but a wider appreciation of their deleterious properties, together with the increasing scope of surgery, has encouraged the use of alternative agents and methods. Although a better understanding of the basic physiology of anæsthesia has done much to improve the efficiency and safety of these standard drugs, their limitations are now undeniable.

There has been, and still is, a widespread belief that the general anæsthetics produce both narcosis and relaxation purely by virtue of their central actions in the brain. Yet, so long ago as 1913, J. Auer and S. J. Meltzer, of New York, showed that ether has a peripheral action as well—that it delays impulse-transmission at the neuro-muscular junctions. Indeed, they described this action as resembling that of curare. This finding remained obscure for many years, until resuscitated quite recently by Gross and Cullen (1943). These later workers also showed that other agents, notably cyclopropane and thiopentone, have the same property, even if in lesser degree than ether. The recognition of this simple fact is now of much importance in the rational application of the relaxing agents as aids to surgical anæsthesia.

The imperative necessity for adequate oxygenation during general anæsthesia has long been acknowledged, even if frequently neglected in minor or major degree. Not only does it lessen the toxicity of the agents employed, but also it favours good relaxation. Admittedly, suboxygenation will to some extent improve the efficiency of the general anæsthetics, but only at the cost of a reduced margin of safety. This is a serious matter with the more potent agents, like chloroform, ether or thiopentone, especially in the cases of gravely ill patients.

The effectiveness of weak agents like nitrous oxide or ethylene is, however, much improved by the deliberate restriction of oxygen during their administration, provided that this lack is neither severe nor prolonged. As regards nitrous oxide, it has been claimed, and promulgated assiduously by the McKesson school, that even gross suboxygenation is innocuous in the presence of this weak anæsthetic (Clement, 1939). Relaxation suitable for all surgical purposes was said to be provided by the procedure of "secondary saturation", whereby the subject is repeatedly carried to the verge of asphyxial death with nitrous oxide and then reprieved by a timely blast of oxygen. Recent neurophysiological research has shown that gross anoxia indeed does impair impulse transmission, both synaptic and junctional (Brooks and Eccles, 1947), thus tending to substantiate the assertion that good relaxation is possible during unsupplemented nitrous oxide and oxygen anæsthesia. Nevertheless, the McKesson concept and practice are now discredited and largely discarded, since they ignore certain essential physical and physiological criteria.

During the past forty-five years a variety of measures which offered prospects of better relaxation during general anæsthesia, as well as in other clinical states, has been extensively studied. Behind them lay the sinister enigma of curare, from which the derivation of any clinical benefit of practical value seemed most unlikely. Yet the surprising outcome of this long study is now common knowledge. Curare has come into its own; its terrors have been largely dispersed. Indeed, further progress seems imminent; "Myanesin", an entirely new development, is under trial, but the results have not been entirely satisfactory (Marshall, 1948). It is now appropriate, therefore, briefly to review the course and implications of this progress.

Magnesium Sulphate.

In 1905, S. J. Meltzer and J. Auer reported in detail on the narcotizing and relaxing properties of the magnesium salts. They found that magnesium sulphate would, in suitable dosage, produce deep and prolonged anæsthesia with complete muscular relaxation. Overdosage caused death from respiratory paralysis. During the next ten years they studied extensively the various possibilities of their discovery, and they propagated its virtues with emphatic pertinacity. Others, notably J. T. Gwathmey (1921, 1928), took up these ideas with enthusiasm, especially with regard to anæsthesia for surgery and obstetrics. In the course of this work Gwathmey originated and expanded the concept of synergistic anæsthesia, which is so commonly employed today. Later, his views suffered much criticism, and finally the promising novelty was relegated to obscurity. Neuwirth and Wallace (1929) showed that a serum concentration of over 20 milligrammes *per centum* was required for the production of narcosis and relaxation, a level unattainable by the recommended parenteral dosages. In addition they proved that the oral and rectal routes of administration were ineffective, since any absorption that did occur was immediately offset by speedy renal excretion. They concluded that the minimal effective parenteral dosage of magnesium sulphate was 0·25 gramme per kilogram of body weight, so that a man weighing 11 stone (70 kilograms) would need 17·5 grammes, or 35 millilitres, of a 50% solution. An echo of this controversy occurred recently, when the use of one millilitre of a 25% solution was recommended as an efficient substitute for curare (Cooper, 1947). The absurdity of this belief was soon exposed by evidence

[1] Read at the seventh general meeting of the Australian Society of Anæsthetists (British Medical Association), Perth, August 16, 1948.

that even a dose of 25 millilitres of a 25% solution, given intravenously, was not strikingly effective (Organe and English, 1947). However, H. E. Yaskin (1940) found that the rapid intravenous injection of 25 to 30 millilitres of a 25% solution greatly reduced the severity of "Metrazol" convulsions (Yaskin, 1941). But the relaxing effect, apparent after about three minutes, lasted for only five or six minutes in all. It therefore seems unlikely that magnesium sulphate could be of value for providing sustained relaxation during surgical operations.

Quinine.

In 1936, A. Wolf reported that quinine salts greatly relieved the muscular hypertonus seen in *myotonia congenita*. In the following year Kennedy and Wolf examined the question exhaustively, and compared the opposed conditions of myotonia and myasthenia (1937). Whereas quinine relieved the former, it aggravated the latter, while the reverse applied when eserine or neostigmine ("Prostigmin") was given. Later, A. M. Harvey (1939, 1940) reported further on the action of quinine and its derivative, quinine methochloride, on neuro-muscular transmission. He concluded that these agents had a curariform action, and that they potentiated the effects of partial curarization.

Quinine methochloride was first prepared by H. King, of London, who also enjoys priority in the isolation of d-tubocurarine chloride (1935). By virtue of its being a quaternary ammonium alkaloid, quinine methochloride is much more potent than its precursor as a relaxing agent. Its action is identical with that of tubocurarine, but in procuring a similar effect the dose required is about ten times larger. Bennett and Cash (1941) have reported favourably on the use of quinine methochloride in "Metrazol" shock therapy.

The foregoing suggests that, while quinine and its derivatives may not be of direct value for aiding relaxation during general anæsthesia, they may well provide a useful basis for the subsequent administration of the curare preparations. Indeed, they may obviate the necessity for curare in some cases, and perhaps give timely forewarning either of idiosyncrasy or of incipient *myasthenia gravis*.

Erythroidine.

Erythroidine exists in two isomeric forms, α-erythroidine and β-erythroidine, of which the latter is the more easily prepared. A tertiary ammonium alkaloid, it is derived from the seeds of plants belonging to the genus *Erythrina*, natural order Leguminosæ (Folkers and Major, 1937). If we view the relaxing agents in general from afar, at any rate as regards their origins, it is rather startling to discover that the coral tree of coastal New South Wales and Queensland, *Erythrina indica* (*corallodendron*), is a ready source of the drug. Further, under the pseudonym of flame tree, it is a present object of beauty hereabouts, although not indigenous to Western Australia.

Both β-erythroidine and its derivative dihydro-β-erythroidine have a strong curariform action. The latter is about six times more potent than the former. Despite this, the necessary dosage of dihydro-β-erythroidine is at least five times greater, in terms of weight, than that of tubocurarine when equivalent effects are desired. The erythroidines, however, are efficient when taken by mouth, and they are said to lack the histamine-like actions of the curare preparations (Unna *et alii*, 1944).

Clinically, β-erythroidine has been proved satisfactory in spastic disorders and convulsive shock therapy (Burman, 1939; Rosen *et alii*, 1940). Recently Dripps and Sergent have reported very favourably on the action of dihydro-β-erythroidine during general anæsthesia (1947). They noted, however, a serious, although not long sustained, fall of blood pressure in a large proportion of their cases. Strangely enough they did not attempt the use of vasopressor drugs for correcting this disturbing complication. Whether this novelty will subsequently prove of value is uncertain; at present it does not seem to approach tubocurarine in efficiency.

Curare.

During the past few years the use of curare in Australia has been sufficiently elucidated in various articles (Daly and Marshall, 1946; Orton, 1947; Troup, 1947), including a recent brief summary (Marshall, 1948), so that detailed elaboration is unnecessary. Three acknowledgements, however, deserve emphasis. The first refers to H. King's isolation of the active principle, d-tubocurarine chloride, which he reported in 1935, as well as to his identification of the essential source, the South American plant *Chondrodendron tomentosum* (natural order Menispermaceæ). The second applauds those American psychiatrists, notably Bennett (1940), who courageously and successfully initiated the use of curare for the prevention of traumatic complications during convulsive shock therapy. And the third honours H. R. Griffith, of Montreal, Canada, who in 1941 overcame the scruples of tradition and prudence by first using curare in clinical anæsthesia, thus launching himself upon an adventure which has since become epoch-making (Griffith and Johnson, 1942).

Neurophysiology.

Because of its important bearing on the subject, it is now appropriate briefly to review the mechanism of neuro-muscular transmission. The nervous impulse excites, at the motor endplate, the formation of acetylcholine. In its momentary existence this substance, by facilitating the progressive depolarization of the various functional elements involved, provokes a contractile muscular response. Almost immediately the acetylcholine is inactivated by an enzyme, cholinesterase. This reciprocal interplay of the effector substance and its antagonist is a constantly recurring phenomenon, permitting immediate and adequate responses to nervous impulses of variable intensity and frequency. The direct application of acetylcholine to muscle fibres free of nervous elements will not, however, induce contraction (Gasser *et alii*, quoted by Shaw, 1948 (*a*)).

In addition to its action at somatic motor nerve endings, acetylcholine has important functions in the autonomic nervous system. It is the chemical transmitter at both pre-ganglionic synapses and post-ganglionic terminals of the parasympathetic apparatus. In the case of the sympathetic, however, it operates only at the pre-ganglionic synapses, the terminal effector being of quite a different nature.

Pharmacology.

Both atropine and curare inhibit impulse transmission of cholinergic type, but for some obscure reason each possesses remarkable selectivity of action. It is said that atropine is most effective where the threshold to acetylcholine is low (parasympathetic terminals) and virtually ineffective where this threshold is high (somatic terminals). Conversely, curare is most effective at somatic terminals, and much less so at the autonomic synapses and parasympathetic terminals. Hence, appropriate dosages of curare will procure adequate somatic relaxation without undue disturbance of the autonomic nervous apparatus. In this connexion it is of interest to note that the motor end-plate region is considered to be homologous with the pre-ganglionic autonomic synapse (Kuffler, quoted by Shaw, 1948 (*b*)), but the clinical effects of curare do not entirely confirm this idea.

Curare acts in the muscle itself by resisting or blocking the effect of acetylcholine. It neither neutralizes nor suppresses the formation of acetylcholine at the end plate, nor does it stimulate that of the antagonist, cholinesterase. Apparently the threshold of the receptor organ to the electrical changes induced by acetylcholine is raised by curare. Thus a sufficiently powerful nervous stimulus may cause the formation of enough acetylcholine to overcome an established curariform effect. Similarly, the antidotes to curare, eserine (physostigmine) and neostigmine ("Prostigmin"), act by increasing the amount of acetylcholine liberated, as well as by depressing the activity of cholinesterase.

The action of curare on somatic muscle varies somewhat in intensity, depending on the vital importance of the muscle groups involved. With a given dose the muscles of cranial innervation are most affected, the peripheral muscles somewhat less, the intercostal muscles even less still, and the diaphragm least of all. Thus it will afford good relaxation without necessarily causing unduly severe or complete respiratory paresis. Of course, with excessive dosage complete paralysis will occur of all somatic muscles, including those of respiration. This selective action somewhat resembles the progressive muscular paralysis which accompanies deepening general anæsthesia.

In the dosages appropriate to most therapeutic requirements curare has no apparent action on the autonomic nervous system and its associated organs. With such restraint no disturbance of cardiac, renal, hepatic or pancreatic function occurs. No changes in the composition or properties of the blood have been recorded. Some writers postulate a central nervous action, but the evidence in favour of this is scanty. Overdosage is said to favour peripheral vascular failure, and impure preparations are

thought to cause bronchospastic manifestations. The drug is either eliminated or destroyed fairly rapidly, but decreasing residual effects do persist for a time, so that repeat dosages must be substantially less than the initial one. The necessity for such additions may be largely avoided by the judicious supplementary use of ether, in view of its recognized curariform action (Auer and Meltzer, 1913; Gross and Cullen, 1943; Marshall, 1948).

Discussion.

A few features only will be mentioned here. The scope and limitations of curare are now well established, but their wider appreciation is still desirable. Stupid abuses, deliberate and unintentional, are too often either seen or heard of. For instance, curare has been employed during thyreoidectomy to relax the taut neck muscles, when a slight reduction of hyperextension would have sufficed. Curare has been given during operations on the hands and feet, to overcome reflex movements, when a little ethyl chloride and ether would have done instead. Alternatively, if one must incline to the spectacular and novel, some pethidine given intravenously would help in such a case. So, too, when troublesome hiccup occurs.

Again, variations in the patience and dexterity of surgeons, and in the competence and temperament of anæsthetists themselves, are significant. A thankless business indeed it is to waste curare on a surgeon who is either apprehensive or scornful about it. Indeed, many surgeons—and patients too—are often better served by spinal analgesia than by general anæsthesia and curare. Further, the anæsthetist who sits by while the patient's chin tugs down with desperate if feeble urgency betrays his physiological ignorance. Here manual aid to respiration is an imperative demand.

Posture is another factor which modifies the application and benefits of curare. The gall-bladder rest may happen to be placed under the lumbar part of the spine. Although the patient may be apnœic, with paralysed diaphragm, the surgeon shortly informs the anæsthetist that relaxation is inadequate. Deeper anæsthesia, or worse still more curare, is demanded, whereas the simple remedy is to place the support just below the scapulæ. The danger when this situation confronts a junior and possibly browbeaten anæsthetist is obvious. Again one recalls an operation for lumbar sympathectomy, performed with the subject in the lateral posture. The surgeon required the uppermost hip and knee joint to be fully flexed. As the operation proceeded the difficulties of access became increasingly onerous. Deeper anæsthesia and more curare were demanded, but this advice was not followed. Several requests were made, by the anæsthetist, for the extension of the uppermost limb, and finally this was done with very good results. Another frequent complaint of inadequate relaxation comes from those surgeons who will perform appendicectomy through the "buttonhole" incision. A direct complication of this absurd procedure is what seems to be a new surgical condition, for which the name "excarceration of the caecum" is proposed. The operator gets the appendix and caecum out, and neglects to tuck the redundant bowel back. The informed anæsthetist quivers with apprehension, for when replacement is attempted some time later such swelling has occurred as to make this manœuvre virtually impossible. Then indeed does the demand for relaxation become really clamorous.

There is one posture which is a virtual contraindication to the use of curare, unless the thoracic cavity is to be opened. This is the prone position, for operations such as dorsal or lumbar laminectomy. Why curare should be used in these cases is a mystery; apparently the bemused anæsthetist feels that it will help him to maintain adequate respiratory exchanges. But the dead weight of the patient, together with the likely presence of two or three pillows under the belly, greatly embarrasses the diaphragm and hinders passive inflation of the lungs. Further, the negative intrathoracic pressure is gravely diminished, so that the consequent impaired venous return of blood will cause a most aggravating local oozing together with reduced cardiac output—a vicious circle indeed. Curarization in the steep Trendelenburg position may also make the control of respiration a most laborious procedure, as well as causing much circulatory embarrassment.

Finally, a "wisecrack" or two. A voluble and critical surgeon became silent a few moments after the use of curare. Observers remarked that if it could silence Mr. X., curare surely must "have something". Another, in the manner of advertised nostrums, runs: "Before—patient rigid, surgeon tense, anæsthetist spastic. After—all relaxed." Like everything else, curare is good within its limits; yet too much of a good thing may be harmful.

Analysis of Cases (d-Tubocurarine Chloride).[1]

Although small and of little statistical value, this series of 126 applications in 122 cases does indicate certain trends in the clinical use of curare.

The preparations employed were (*a*) "Tubarine" (Burroughs Wellcome and Company—112 cases), and (*b*) d-tubocurarine chloride (Drug Houses of Australia—14 cases)—a total of 126 administrations in 122 cases.

The sexes of the patients were as follows: 46 were males, 75 were females, and the sex of one was not recorded—a total of 122 cases. The preponderance of females was due to the frequency of gall-bladder and pelvic operations in the series.

TABLE I.
Site and Nature of Operations.[1]

Site.	Procedure.	Number of Cases.
Upper part of abdomen.	Laparotomy	12
	Gall-bladder operations *et cetera*	32
	Operations on stomach and bowel	5
	Repair of incisional hernia	1
Total		50
Lower part of abdomen.	Appendix removal; hernia repair	7
	Bladder and prostate operations	8
	Abdominal section (including operation for ectopic pregnancy)	7
	Cæsarean section	2
	Hysterectomy	20
	Colostomy	1
	Drainage of abscess	1
Total		46
Kidney and ureters	Nephrectomy	2
	Ureterolithotomy	1
Total		3
Thorax *et cetera*	Hemicesophagectomy	1
	Jejuno-œsophageal anastomosis	1
	Transthoracic gastrectomy	2
	Thoraco-lumbar sympathectomy	12
Total		16
Pharynx	Biopsy	1
No record		5
Grand total		121

[1] In addition curare was employed for shock therapy five times in one case; the total number of administrations was thus 126.

The age groups were as follows: under thirty-one years, six patients; thirty-one to forty years, 21; forty-one to fifty, 33; fifty-one to sixty, 35; sixty-one to seventy, 13; over seventy, 10; no record, four; total, 122 cases. The fourth, fifth and sixth decades account for the majority, with a decline in the seventh and eighth decades, indicating selectivity for either special or aging subjects. Statistical correction would probably show a greater relative application, in the later age groups, than these figures indicate.

The surgical "risk" distribution was as follows: "A", 20 patients; "B", 61 patients; "C", 36 patients; "D", three patients; no record, two patients; total, 122. These figures also indicate a definite selectivity for the less favourable subjects;

[1] At this stage a cinematographic film entitled "d-Tubocurarine", kindly lent by Burroughs Wellcome and Company (Australia), Limited, was screened. It provided a good schematic demonstration of the action of the drug, as well as showing its experimental and clinical use.

the same qualification regarding statistical correction would probably apply to the categories "C" and "D".

The site and nature of the operations were as shown in Table I. Nearly 79% of the operations (including genito-urinary work) were of abdominal character. In these curare was used mainly for aiding relaxation and reducing the toxic effects of the agents employed. Nearly 13% involved an open thorax; here curare facilitated control of respiration and favoured the use of non-inflammable anæsthetic mixtures. Otherwise, the need for curare in work outside the peritoneum and on the head or extremities was virtually negligible. Therapeutic use of curare covered five applications of electro-convulsive therapy in a case of involutional melancholia; the results were good.

TABLE II.
Types of Anæsthesia.[1]

Type of Anæsthesia.		Number of Cases.
Basal.	Supplementary.	
"Pentothal" (intravenously)	——	12
Intravenous administration.	Ethyl chloride, ether ("open")	3
Intravenous administration.	Nitrous oxide, oxygen	5
Intravenous administration.	Nitrous oxide, oxygen, ether	14
Intravenous administration.	Nitrous oxide, oxygen, cyclopropane	30
Intravenous administration.	Nitrous oxide, oxygen, cyclopropane, ether	28
Intravenous administration.	Cyclopropane, oxygen	3
Intravenous administration.	Cyclopropane, oxygen, ether	1
Nitrous oxide and oxygen.	Ether	12
Nitrous oxide and oxygen.	Cyclopropane	4
Nitrous oxide and oxygen.	Cyclopropane, ether	3
Spinal analgesia.	Nitrous oxide, oxygen, cyclopropane	1
No record.		5
Total		121

[1] In addition curare was used five times in one case for shock therapy—a total of 126 administrations.

The types of anæsthesia used are shown in Table II. A preference for synergism instead of "minimal" anæsthesia will be noted. The use of intravenous anæsthesia was significant in just over 76%, mostly for induction. Ether was used in just over 48%, mainly to potentiate the residual effects of curare given earlier. Cyclopropane was useful in just over 55%; it was favoured more as a supplementary agent than as the sole anæsthetic agent. Curare was rarely given to aid intubation; topical analgesia was preferred.

TABLE III.
Dosages.

Amount. (Milligrammes.)	"Tubarine." (Number of Cases.)	d-Tubocurarine Chloride.[1] (Number of Cases.)	Total.
10	8	1	9
15	88	—	88
18	1	—	1
20	4	13	17
22	1	—	1
25	1	—	1
30	3	—	3
32	1	—	1
No record	5	—	5
Total	112	14	126

[1] Supplied by Drug Houses of Australia.

The dosages used are shown in Table III. The preparations were supplied as 1% solutions, in ampoules of 1·5 millilitres (15 milligrammes) and 2·0 millilitres (20 milligrammes) respectively. The small dosages quoted further indicate a preference for synergism with the anæsthetic agents employed. It is evident that the size of the ampoules largely determined the quantities of curare used (83% of cases); cost and convenience are significant here. Although it is somewhat arbitrary, the practice represents "basal curarization", the slightly variable effects of which are readily improved or prolonged by suitable anæsthesia. It is no more arbitrary than the usual assessment of dosage on the basis of 1·5 or 2·0 milligrammes per stone of body weight.

The results are set out in Table IV. Subjects who developed apnœa, especially during the use of supplementary ether, are included in the first category, since spontaneous breathing was easily restored by hyperventilation, without carbon dioxide absorption, towards the end of operation. The quantity of ether taken up was truly "minimal", and so was rapidly eliminated.

The complications are set out in Table V. No unusual incidence of complications was evident. Hypotension occurred chiefly during sympathectomies; it was due to unduly large preliminary dosages of barbiturates. Bad posturing is the fault of either the surgeon or the anæsthetist; curare may aggravate the situation. Vomiting was due to sensitivity to morphine. Curare was not significant as a cause of ileus or atelectasis. It may have been a factor in shock; this is readily corrected by suitable therapy, especially with ephedrine. It was also a possible factor in tachycardia, which was typically paroxysmal in two cases. Deaths occurred from forty-eight hours to three weeks after operation; curare was not implicated.

TABLE IV.
Results.

Result.	"Tubarine." (Number of Cases.)	d-Tubocurarine Chloride.[1] (Number of Cases.)	Total.
Good	99	12	111
Fair	8[2]	2[3]	10
Bad	—	—	—
No record	5	—	5
Total	112	14	126

[1] Supplied by Drug Houses of Australia.
[2] Dosage inadequate in three cases.
[3] Potency doubtful in two cases, despite the use of 20 milligrammes in each.

TABLE V.
Complications.

During Operation.	Number of Cases.	After Operation.	Number of Cases.
Laryngospasm (brief)	2	Undue vomiting	3
Hiccup (transient)	2	Ileus (moderate)	2
Hypotension (temporary)	8	Tracheobronchitis	3
Cardiac arrhythmia	1	Atelectasis (localized)	2
Postural embarrassment	5	Shock (mild)	6
		Tachycardia	3
		Venous thrombosis (localized)	3
Deaths	—	Deaths	5

Summary.

1. Modern surgery makes very great demands on general anæsthesia, which the standard methods and agents of the past can no longer fulfil.

2. The necessity for perfect muscular relaxation, formerly met only with excessively deep anæsthesia, is now satisfied by improved techniques as well as by ancillary agents, such as curare.

3. The peripheral curariform action of ethyl ether has been known, but largely disregarded, for nearly thirty-five years. This property is achieving increased recognition in the synergistic procedures employed by anæsthetists today.

4. Gross suboxygenation, as formerly seen in the major applications of nitrous oxide and oxygen, impairs neuro-muscular transmission and so favours relaxation; but its practice is now discarded because of the gravely serious risks involved.

5. The possible utility of magnesium sulphate, quinine and erythroidine for aiding the production of muscular relaxation during surgical anæsthesia and other clinical states is reviewed.

6. The neurophysiological and pharmacological attributes of curare are examined, and the superiority of its preparations for the above purposes is indicated.

7. Various abuses of the curare preparations are discussed, and the advisability of employing simpler alternatives whenever possible is emphasized.

8. An analysis of 126 applications of d-tubocurarine chloride in 122 cases is presented, from which it is concluded that moderation in dosage, restriction to suitable cases and rational combination with other agents are essential requisites.

9. Quite distinct chemically, "Myanesin" is an efficient relaxing agent, but has certain deleterious properties which make its clinical use questionable.

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THE AGING MAN IN THE MODERN WORLD.[1]

By F. PHILLIPS,
Hobart.

I SHALL first describe what I mean by an aging man and then what I mean by the modern world.

The bodily tissues of any animal begin to decline in quality even from birth. Eventually this decline in quality becomes so obvious as to be described as senescence. No bodily tissue or organ escapes. The hair becomes thinner and less pigmented. The skin becomes tough and inelastic; it tends to hang in folds. The arteries harden; the muscles accumulate increasing fibrous tissue at the expense of muscular tissue. Sclerosing changes occur in and about the joints. In the eye the iris becomes more rigid. The pupillary reactions become sluggish, the pupil does not readily dilate. The crystalline lens becomes more rigid, the amplitude of accommodation therefore decreases.

This is not all, but it is enough. The prospect is depressing. The changes of senescence are inevitable and progressive. The aging man has no escape. His physical powers, his bodily tissues deteriorate further and further, until all is nailed down in a wooden box.

I have described a train of events which has happened millions of times in countless centuries. It still happens in the modern world and will in centuries to come.

But the modern world manifests certain characteristics which confront an aging man with an especial problem. I shall now speak of the modern world.

We hear so much of progress and of the advantages of our world. But there are disadvantages, and not minor disadvantages either.

We have so much now that our ancestors did not have. I have a motor-car, a radio set, a hot-water service, electric light in my home; and other things commonplace to us, yet unknown a century ago. Surely then the twentieth century, in which we live, is better than the nineteenth century. Well, I should say not. On the balance I consider that the nineteenth century weighs out better.

Consider the nineteenth century. It began with war. An adventurer from an obscure Mediterranean island placed his personal ambition above the happiness and welfare of millions of humanity. Yet by comparison with his latter-day imitators, what a gentleman he was! And when he was consigned to a well-deserved isolation there was peace for a century. A few small wars there were, but minor affairs by our standards. Nobody in the nineteenth century had the experience of living through two world wars.

An economic phenomenon which began in the nineteenth century was inflation. This upward spiral of prices and wages was then observed to occur, but it was not alarming. It has remained to our century to see what inflation can really mean.

Another characteristic of our time is taxation. Now, taxation has existed for centuries. Income tax was introduced in the nineteenth century, but how it has since grown!

Taxation is heavy for two reasons. Firstly and obviously, because of world wars, which are horribly expensive. Secondly, and less obviously, because of the terrible generosity of politicians. All politicians have the urge to play Father Christmas with somebody else's money. They shower benefits to be paid for by the taxpayer. Their hearts bleed for poor poverty-stricken Paul; they pay Paul, which necessitates the robbing of Peter. They establish social services, every one of which is a millstone round the taxpayer's neck.

I have myself no faith in the benevolence of the State. Although it is an abstraction, I regard the State as one of the devouring monsters, such as tigers, crocodiles or sharks.

Now how does this affect the aging man? When a man realizes that the prime of manhood passes, vitality wanes,

[1] Read at a meeting of the Tasmanian section of the Ophthalmological Society of Australia (British Medical Association) on March 19, 1949.

and earning power decreases, he will begin to plan for his retirement.

In the nineteenth century this was not difficult. A man would save money to invest in property or in shares. Then when his family grew up and were self-supporting, his investments would be sufficient to provide a competence. If a man conducted his affairs with prudence he could be certain of retiring in some degree of comfort. This happy state of affairs has ceased to exist. A man may still work and earn, but nowadays taxation takes a heavy toll on earnings. And the harder and harder a man works, so the harder and harder are the demands of the Federal Treasury.

Money can be invested. But interest rates are low, property income is restricted by fair rents acts and the like. And, further, investment income is heavily taxed.

Provision for retirement is often made by superannuation. A man pays in for perhaps about thirty or forty years then begins to draw out. The trouble here is inflation. Very much inflation can occur in that time. The value of money is not constant. The money paid in at the beginning was a sacrifice. The money drawn out at the end has become of little value.

The same applies to endowment assurance. It is no fault of the life assurance companies that inflation exists; but it does, and it greatly diminishes the value of life assurance.

One method of providing for retirement is of especial interest to medical practitioners. When a man has ceased to practise, he will realize on his practice, which may be a valuable asset. The money accruing from the sale of his practice will be collected at the beginning of retirement which is just the time when it will be most needed.

In England, where practices usually have sold at higher prices than here, this has been most important. Now Mr. Aneurin Bevan has set himself very strongly against the sale of practices. He has most eloquently denounced this old-established custom. In his new National Health Service all this is abolished. He has made many concessions in order to persuade medical practitioners to enter his new service; but on the matter of sale of practices he has conceded nothing.

Supposing then that a man of our time is planning his retirement. He may consider saving, investment, superannuation or life assurance. In every direction he may look he will find that circumstances are against him.

Supposing he decides to take what the State may offer. He will find that the number of pensions applicants is large, but the funds available for them are restricted. It divides up into very little among so many.

When the State takes, it is rapacious and demanding. When the State gives, it is niggardly and grudging. The man who has for a lifetime poured most of his earnings into the coffers of the State will find at the end that he is offered only a subsistence.

Note that word subsistence. It is a long way below competence. It is a short way above the grades of destitution and starvation.

Baffled at every turn, what can the aging man decide to do? I will give you the answer I have reached. He cannot hope to retire; he must continue to work.

This state of affairs is regrettable, but I would not call it tragic. Many have striven towards the goal of retirement—no compulsion to rise before 8 o'clock on Monday morning, no need to earn money any more, no need to worry about holding down a job, no need to worry if the business will pay. For years this looks like an early paradise, and at last it is attained. And what is it then? It is a life of idleness, of futility, of boredom—an empty purposeless existence.

In this modern world the older generation is of more value than in previous centuries. In our age of machines, physical capacity matters less and less. But knowledge is more valuable than ever. In our time accumulated scientific knowledge has piled up to tremendous dimensions. In medicine, in engineering, this has necessitated the division of the profession into specialities, of which the number ever increases. The older man has knowledge and experience which the younger man simply has not had time to acquire. We need therefore to retain the older generation. In the past it has happened that men have gone out of active life still with large unexpended reserves of vitality. Such wastage can no longer be permitted.

Every man who goes on to an old age pension should be regarded as a deserter from the army of the taxpayers over to the enemy, the army of the tax-eaters. The only valid excuse should be mental or physical incapacity. The attainment of some arbitrary figure, such as sixty-five years, should not thrust a man out of active life.

I envisage a future in which there will be many men in their seventies or eighties still actively working and earning owing to the circumstances which I have described. These men will be valuable owing to their extensive experience, but their physical powers will be enfeebled. Everything must be done to help them.

A new medical specialty is emerging, the specialty of geriatrics. The aim is to improve the efficiency of the older generation who now make up a larger proportion of the community than was the case in previous centuries.

But fundamental research is also being conducted into the problem of senescence. Even though we must accept the inevitable, may it not be possible that senescence could be considerably retarded? Must we always be contented with the present life span? I will say not. Our life span is too short, and more than that, a more serious objection is that it is badly proportioned. Too much of our life span is spent merely in attaining maturity. In many animals this takes only a fifth of the life span, and it should not be more.

Great practical inconvenience arises from this disproportion in our life span. Those who aspire to a professional status must retard the age at which economic independence can be reached. Usually there then ensues a brief and happy period of being neither dependent nor having dependants. I sigh for that happy time when paying school fees or discharging one of the many and heavy obligations of parental responsibility.

It commonly happens that a man reaches the end of his earning life, that is to say, sixty-five years, still with dependants who have not attained, or who have barely attained, economic self-sufficiency. I call this a sorry state of affairs. I consider that a man should have a life span long enough to rear all his offspring and see them self-supporting and yet to retain ability to earn beyond that. He should have at least another twenty years with no dependants, other than his wife.

I have described the economic and political stresses of our modern world. Of these the aging man is the victim. I have no remedy to offer; on this side of the problem I am utterly despairing. It is desirable that the useful earning life span should be considerably extended. How should this be done? This is not a new problem, but we still await a solution.

Among the attempts I would mention Metchnikoff with his *Bacillus bulgaricus*, Voronoff with his testicular grafts, Steinach with unilateral vasectomy, and the Russian bee-keepers. Lacking a fundamental solution to the problem of senescence, I shall briefly review the partial solutions, that is to say, the gadgets. Now each of these has a limited range, its application is to only one small aspect of the vast problem of senescence. Yet gadgets can be important.

This is well illustrated by the normal death of the sheep. At about the age of six years, the front teeth loosen and fall out; the sheep is then known as a gummy. A gummy cannot crop the grass and eventually dies of starvation. The provision of dentures for sheep is not an economic proposition. Hence the mere lack of a gadget determines the end of existence.

It is an old story that the ocular efficiency of the aging man can be bolstered by artificial devices. The rigidity of the pupil reduces the efficiency of the eye in dim illumination. A man at fifty needs approximately three times as much illumination for reading as would have sufficed in

childhood. Considerable improvements in artificial illumination have sufficed in recent years, hence this need should not be difficult to supply. Bifocal glasses were invented by Benjamin Franklin over a century ago and this device alone has improved the earning powers of millions of aging men.

The hearing aid is a more recent help to the aging man. It is not long since swindlers and quacks were the principal purveyors of hearing aids. But inventions in the field of radio have come to be applied to the hearing aid so that it has ceased to be necessary to warn the deaf against them.

But most important of all is the attitude of the community towards its aging members. I here protest at the prevailing custom of thrusting into retirement almost every man who attains the age of sixty-five years. I protest against the assumption that a man of this age is too senile to be of any further use. I do urge that all who are able and willing should continue to work. This modern world, with all its scientific improvements, is by no means favourable to the aging man. Politically and economically he is under attack. It is only medically that he can be aided.

Reviews.

FOREBRAIN EVOLUTION.

DR. SCHEPERS, who is well known for his work on the brain of the chelonian reptile, *Testudo geometrica*, and for his analysis of the endocranial casts of the *Australopithecinæ* discovered by Dart and Broome (both, incidentally, Sydney graduates) in South Africa, has now attempted to bridge the gap between these two extremes in a volume on forebrain evolution as a whole.[1] Perhaps the main title of this book is rather misleading, since eleven of the sixteen chapters are devoted specifically to *Testudo*—although there is much incidental discussion of homologies—and only the last five are concerned with other vertebrates. The account of the brain of *Testudo*, which includes a description of the blood supply, is so detailed that attention here can be concentrated only upon some of the most important factors in forebrain evolution. In the cerebral cortex the author adopts the conception of para-, or secondary, hippocampal and pyriform formation as advocated by Dart, Shellshear, Craigie and Abbie, and he considers that the *primordium neopallii* (of Crosby) is composed of the medial parts of those formations. This view supports Abbie's findings for monotremes and marsupials. From the neopallial part of the *primordium* the author could trace non-olfactory fibres to and across the fornix commissure, thus confirming Abbie's earlier observations on monotremes and marsupials. The detailed analysis of the cell masses of the basal nuclei does not lead to any novel conclusions, but the description of the *primordium* of the neostriatum supports the view of Elliot Smith, Goldby, Abbie and others that this structure is produced by hypopallial infolding from the pyriform region. In the matter of blood supply Schepers adopts a cautious version of the principle of constancy of vascularization advocated by Shellshear and modified by Abbie. He could produce no convincing evidence that the cerebral cortex in reptiles is excitable, as is claimed by Johnston, Bagley and others, but denied by Wilson, Goldby and Abbie.

Application of the findings in *Testudo* to an all-embracing pattern for the vertebrate telencephalon occupies nearly a third of the book and extends from the putative ancestors of the vertebrates up to man. The author surveys the Arachnid, Nemertian, Balanoglossus, Appendicularia and Annelid hypotheses, but does not appear to be familiar with the more recent and convincing Echinoderm hypothesis; his final appeal to the *élan vital* of Bergson is not likely to carry much conviction. This section, indeed, is purely theoretical and betrays lack of first-hand knowledge of many of the kinds of brain discussed, as well as ignorance of much of the recent literature on the subject. However interesting the discussion is, it leaves too many gaps to be bridged and serves rather to disclose how much has yet to be done in this field.

The book, which is dedicated to Professor Dart and contains a foreword by the late Dr. Ariëns Kappers, is well produced and abundantly illustrated. A mild protest might be entered against the excessive use of abbreviations in the figures and text; also, some of the figures are too crowded for comfort. On the other hand, the tables summarizing the views of different authors are exceedingly useful. Altogether, Dr. Schepers is to be congratulated upon the valiant and imaginative way in which he has tackled this very difficult problem.

[1] "Evolution of the Forebrain: The Fundamental Anatomy of the Telencephalon with Special Reference to that of Testudo Geometrica", by G. W. H. Schepers, D.Sc., M.D.; 1948. Cape Town: Maskew Miller, Limited. 11" × 8½", pp. 228, with 250 illustrations. Price: 50s.

THE TREATMENT OF PEPTIC ULCER.

"THE MODERN MANAGEMENT OF GASTRIC AND DUODENAL ULCER", edited by F. Croxon Deller, is the result of the efforts of five named contributors.[1] H. C. H. Bull supplies the radiological discussion, R. S. Johnson provides the medical viewpoint and J. A. Lee that of the anæsthetist, while the surgical approach is provided by A. K. Munro and R. Maingot.

After a discussion of the causation of ulcer, Johnson states that it has to be admitted that the problem is still incompletely understood, though he stresses the importance of hyperacidity and the psychosomatic build-up of the patient as factors. Symptoms, clinical examination, special investigations, differential diagnosis and complications are all adequately discussed. In regard to choice of treatment, he writes: "Note will have to be made of the effects of any previous treatment given, the nervous disposition and emotional make-up, the occupation and habits of the patient." Lastly the economics of the disease and the amenability of the patient to undergo treatment and the presence of focal infection and its possible elimination must not be neglected. Johnson favoured Witt's modification of the Meulengracht diet. The surgical section is well done and Maingot appears to favour the Pólya-Hofmeister subtotal gastrectomy. For the sake of completeness it is a pity that Finochietto's technique of the Billroth I operation and also a discussion of the surgery of high gastric ulcers are not included. This is, however, a most useful book for students and graduates and provides them with, as the author intended, "a balanced and educated account of the modern trends in the management of these diseases".

SOME ASPECTS OF HOSTILITY IN YOUNG CHILDREN.

A. K. KORNER is to be congratulated on an interesting research, the results of which are published under the title "Some Aspects of Hostility in Young Children".[2]

The author reviews the literature on projective techniques and uses one which falls into a broad category, which includes such diverse entities as the Rorschach ink blot and the thematic apperception tests. She employs stories for completion and dolls and other play material for drama.

Twenty normal children in the four to six years age group were examined in a kindergarten. Each child was presented with ten incomplete stories, such as: "Daddy comes home just when the little boy has to go to bed. The little boy did not see his daddy for a whole day and he missed him. But as soon as daddy comes in, mommy takes daddy away to talk to him. What does the iittle boy feel like doing when daddy gives all his attention to mommy?"

Dolls representing the family composition and doll furniture were presented to the child who illustrated the answers.

At another interview free play was allowed.

In addition, parents and teachers were interviewed.

The data were analysed and the sum of hostility tallies were charted. It was found that hostility in both play and real life situations was universal, though it differed in intensity. There was a striking inconsistency between hostility in controlled play at the kindergarten and at home. This has important implications since it indicates

[1] "The Modern Management of Gastric and Duodenal Ulcer", edited by F. Croxon Deller, M.D., M.R.C.P.; 1948. Edinburgh: E. and S. Livingstone, Limited. 9" × 6", pp. 230, with illustrations. Price: 20s.

[2] "Some Aspects of Hostility in Young Children", by Anneliese Friedsam Korner; 1949. New York: Grune and Stratton. 8½" × 5¼", pp. 112. Price: $3.50.

that no reliable inference can be made on a child's hostile behaviour in real life from that in phantasy life.

The author finds four patterns of behaviour: "(*a*) Children who showed strong hostility in the play and real-life situations; (*b*) children who showed mild hostility in all situations; (*c*) children who showed strong hostility in the play situations and very little in actual behavior; and (*d*) children who showed mild hostility in the play situations and strong overt hostility in the real-life situations."

No relationship as to the child's general adjustment could be discovered. Analysis revealed a variety of mechanisms. Some children used play to work out hostilities; in other cases this was not done.

The hostilities in real life were due to various causes. Anxiety was a basis in some. Others retaliated against parental frustrations.

For the non-expression of hostility some feared loss of parental affection, others assimilated it in play and phantasy, others were just placid children. Whilst rejection by parents is a cause of hostility, its results are variable.

The author concludes with some interesting comments on corporal punishment. She found that it tended to be given to children who were strongly hostile in real life. "Moderate discipline was associated with submissive behavior in both play and real life. If severe corporal punishment is viewed as one form of parental impulsiveness, this finding falls in with the observation that generally the children of this group imitated their parents' reaction pattern with respect to 'acting-out' behavior. Most of the children with parents who vented their feelings and annoyances impulsively felt free to express their own hostility in parallel manner. It follows that these children witnessing the impulsive nature of their parents' modes of discipline would give vent freely to their own hostility in a similarly impulsive way."

Those who deal with child guidance clinics will strongly support the implication that treatment must commence with the adjustments of the parents' own emotional problems. The author pleads for a balanced individual approach to each personality problem. The book is worth a place on the shelves of any practitioner interested in child behaviour problems.

ELEMENTARY ANÆSTHESIA.

ALTHOUGH beautifully produced, with many fine illustrations, William N. Kemp's book, "Elementary Anesthesia", is not a very impressive work.[1] It is a somewhat disjointed account of personal opinions rather than a comprehensive examination of those essentials which are important to students and recent graduates, for whom we presume it is intended. Yet it does possess substantial merit, even if this may be fully appreciated only by those specially informed in the subject.

Good writing is hard work, criticism is easy. Unhappily this book invites more condemnation than approbation. The writer certainly deserves congratulation for his effort, as do the publishers for their product. The result, however, is not satisfactory; it must confuse and mislead the beginners and irritate the pundits in the speciality of modern anæsthesia. The work contains far too many errors of fact and interpretation to be of significant value to anyone really interested in this most important clinical activity. Whatever useful information is presented is so distorted by evident bias, omissions, obscurity, indifferent writing and improper emphasis that its validity is largely destroyed. Even if notable authorities are frequently quoted, the proper explanation or elaboration of their views is too frequently neglected. The obviously wide experience of the author thus becomes sadly vitiated by his literary and factual inadequacies. The publishers, too, must be held responsible for various typographical errors, as well as for the evident neglect of adequate proof-reading.

Further condemnation is distasteful but inevitable. Gross chronological and other errors occur frequently from the opening historical section onwards. For example, Morton is said to have given his first public demonstration of ether anæsthesia on November 7, 1846; this occurred, of course, on October 16 of that year. The name of Hickman, that frustrated English investigator, is repeatedly spelt "Hinckman", and he is alleged to have experimented with nitrous oxide in 1810—remarkable precocity when it is realized that he was born in 1800. It is a dubious honour to John Snow to describe him as the first "Anesthesiologist" of London, England. Priestley would no doubt be affronted by "Priestly", as would Humphry Davy by the familiarity of "Humphrey", while the spectre of Horace Wells must surely resent his relegation (on page 75) to 1846, when truly he anticipated the upstart Morton by nearly two years. Perhaps these are unimportant considerations, but such liberties colour the work adversely, and these unhappily are perpetrated further in various subsequent respects.

Quite erroneous data of the physical and other properties of certain volatile and gaseous agents, notably ether and nitrous oxide, are presented. The density of ether vapour at 150° C. is certainly not 0·718, and the specific gravity of its liquid is not 2·6. If the "vagus action" of morphine may cause bradycardia, it surely cannot impair gastric motility. That ether lowers the glycogen reserve by 58% is impossible exactitude. So, too, the assertion that chloroform causes the blood-glucose content to go "up 200%". That nitrous oxide boils at 89° C., and requires the presence of oxygen to support combustion, is nonsense. How dangerously misleading is all this for those seeking accurate instruction and knowledge, even if the information is not of great practical significance!

Again, the author's unreserved approval of Negovski's impracticable method of retrograde arterial perfusion for cardiac resuscitation, to the neglect of simpler and frequently effective procedures, is alarming. Correctly, if repetitiously, he states that cardiac arrest, especially with chloroform, is the *"bête noire"* of anæsthetists, and rightly he so emphasizes the combined dangers of chloroform and adrenaline. But to include inflation with oxygen and auricular puncture as after-thoughts must lead many tiros to disaster, and many patients to paradise.

Reluctant mention must be made of several other quite astonishing statements in this book. That all meat must be excluded for four days before operation, while a protein intake of 100 grammes daily is essential, can be regarded only as the delusion of a "crank". That carbon dioxide absorption, especially with "controlled" respiration, carries grave hypocapnic and anoxic risks belies all modern practice and experience. That vaso-pressor drugs are of little value in spinal analgesia is absurd. That "emergent" (page 50) means emergency, and "hypothecate" (page 195) means hypothesize (or, say, state, submit, postulate or assert) are abuses of our English language. To confuse formaldehyde with paraldehyde (page 133) is a terrible mistake. The stenographer may indeed have recorded these things, but surely the writer is responsible for their correction!

Yet, this author has many excellent attributes, which modify greatly the foregoing denunciations. His practical points, where stated, are really good. The psychological approach to his patients, especially children, is admirable and tempered with deep sympathy. Although his views about carbon dioxide are somewhat distorted and exaggerated, he presents an arresting discussion on the effects of its severe restriction and the possible influence of this in the causation of convulsions during general anæsthesia. His brief section on shock is admirable, if superficial. He gives a fairly good account of spinal analgesia and describes adequately the more useful applications of regional analgesia. The penultimate chapter on *status lymphaticus* (his pet subject) is interesting, even if not entirely acceptable here. A few brief references to the use of anæsthesia and analgesia in non-surgical conditions, and a satisfactory index conclude the work. But despite all this, it cannot be recommended for general perusal.

[1] "Elementary Anesthesia", by W. N. Kemp, M.D.C.M.; 1948. Baltimore: The Williams and Wilkins Company. Sydney: Angus and Robertson. 9" × 5", pp. 310, with 100 illustrations. Price: 37s. 6d.

Notes on Books, Current Journals and New Appliances.

POST-GRADUATE LECTURES IN MEDICINE.

A FOURTH VOLUME of "Edinburgh Post-Graduate Lectures in Medicine" has been published.[1] The lectures have previously been published in the *Edinburgh Medical Journal*. They were delivered and are published under a grant from the trustees of the late Mrs. Honyman Gillespie. There are 41 lectures dealing with a variety of subjects and they have been prepared by 42 authors. Many of the articles have a direct clinical bearing; others deal with such subjects as the administration of drugs, the chemistry of cell nuclei, the ætiology of *diabetes mellitus*, the basis of prognosis, growth in relation to maturity. The volume is well and attractively produced.

[1] "Edinburgh Post-Graduate Lectures in Medicine", Volume IV; 1948. Edinburgh, London: Oliver and Boyd. 9½" × 6", pp. 604, with illustrations. Price: 18s.

The Medical Journal of Australia

SATURDAY, AUGUST 13, 1949.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: surname of author, initials of author, year, full title of article, name of journal without abbreviation, volume, number of first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

RESULTS ALONE ARE NOT ENOUGH.

WHEN an undergraduate student qualifies in medicine his future attitude to his profession, his true success in other words, will depend on his ideas and his ideals, and also on the way in which his medical teachers have taught him. If he has chosen medicine as a career because it is a satisfactory way of earning a living and because he hopes as a medical practitioner to enjoy a certain social status, he may be expected from the moment of graduation to pay most attention to those aspects of medicine which will help him to achieve those ends. If, on the other hand, he has during his undergraduate days become seized with a desire to know why the ordinary course of a man's life is disturbed, why one man differs from another in make-up and in his response to harmful agents, and how pathological change, once started, develops to produce the full-flowering manifestation of disease, his professional life will be different from that of what we may call his more mercenary fellow practitioner of the first-named type. His desire to know why will mean that he has absorbed something of the tradition of medicine, which is that of a science as well as an art. He may still be able to earn enough to provide for himself and his family in a reasonably generous fashion and he may enjoy a social status not inferior to that of any of his brethren, but he will have joined in one of the most absorbing and satisfying of human quests. Of course, there are all types of practitioners between the frankly mercenary and the ideally inquisitive, and all that we can say for those of what we may call the lesser breed is that they should essay the path of inquiry, for here indeed appetite grows with feasting. Everyone will admit that it is of the first importance that a medical attendant should know what treatment he should order for his patient; at the same time we must realize that this is not the end of the matter. It is more important to know why than to know how—to know why disease comes than to know how to treat it. To know how to treat a manifestation of disease without knowing how it comes is to practise empiricism. To know how and why a disease arises, what are the steps in its development and what changes it produces in the tissues of the body, is to give a logical basis for treatment. In this way treatment may become simplified, and even unnecessary, for full understanding may make prevention possible.

All this is true of general medicine, but the arguments used about it become more cogent when we turn to special branches of medicine and those who practise them. Osler had a good deal to say about this. In his book "Æquanimitas" he has a chapter on the student life. He insists that a student entering on a medical course is entering on a life course, for which the work of a few years under teachers is but a preparation. When therefore he wishes to refer to the specialist in medicine, he calls him the "student-specialist". This student-specialist, Osler states, has to walk warily, because although he enjoys advantages, there are two great dangers against which he has constantly to be on guard. The specialist is able to work in a comparatively narrow field which can be "thoroughly tilled"; this gives great satisfaction to many men. Again, as a rule the specialist is a free man with at any rate some leisure. He has not to face the incessant demands that are made on the general practitioner; he may live a more rational life and has time to cultivate his mind. The dangers, Osler states, do not come to the strong man in a specialty, but to the weaker brother who seeks in it an easier field in which "specious garrulity and mechanical dexterity" may take the place of solid knowledge. "All goes well", he writes, "when the man is larger than his specialty and controls it, but when the specialty runs away with the man there is disaster, and a topsy-turvy condition which, in every branch, has done incalculable injury." This danger from small men is the first of those awaiting the specialist; the second envisaged by Osler is the serious loss of perspective in prolonged and concentrated effort in a narrow field. In a recent Harveian Oration[1] on "The Structure of Medicine and its Place Among the Sciences", delivered at the Royal College of Physicians, London, on October 18, 1948, F. M. R. Walshe put the matter topically and figuratively by the remark that some might prefer to drive a motor-car without bothering about what is going on under the bonnet, and might fancy that the results are good enough. He remarked that as a motorist he cordially acquiesced in such a form of escapism, but that as a physician he rejected it wholly, for "we are members of a learned profession with responsibilities to keep it so". He thought that the willingness to drive without a care of what was going on under the bonnet was more likely to come of intellectual sloth rationalized as practical common sense, or from the comforting persuasion that freedom to think implied also freedom not to think, than from any deep conviction that it was possible for us to do our best without knowing something of how we were doing it. Osler saw only one safeguard for the specialist—the cultivation of the sciences on which the specialty is based. Walshe used the following words:

> . . . we must surely aim at the highest degree of understanding of the foundations of our thoughts and actions, and I submit that the capacity to advance knowledge materially and to develop a due critical faculty are both impossible on the plane of "practical common sense", and to be content to dwell exclusively thereon means that we must inevitably

[1] F. M. R. Walshe: "The Structure of Medicine and its Place Among the Sciences", Harveian Oration, 1948. Edinburgh: E. and S. Livingstone. 7¼" × 5", pp. 26. Price: 1s. 6d. net.

decline to the level of craftsmen and technicians, and our profession to a chaotic medley of technologies.

The content of the specialties in medicine has in recent years undergone a good deal of change. The specialist knows that the basal sciences and the ancillary sciences and indeed other specialties, as well as the mental make-up of the patient, have a bearing on this whole field of his own endeavour, however restricted it may appear to be. A specialty may appear to be more restricted than it really is. For example, the neurosurgeon must be a neurologist as well as a surgeon restricting his operative activities to the nervous system. The urological surgeon must be familiar with every aspect of the excretory system—he is a urologist and not a urological surgeon. The gynæcologist is much more than a gynæcological surgeon. And so on. The programmes of meetings of those who study and practise in special fields of medicine and the tables of contents of their journals give evidence of much time and thought spent on what to do and on the results of treatment. The present is a plea for more attention by specialists and by physicians as well as by general practitioners to the basal subjects of physiology, biochemistry, nutrition, experimental pathology, bacteriology, immunology and so on. There is no suggestion that these subjects are being deliberately neglected; it is suggested, however, that with the rapid changes that are being made in treatment, with the enthusiastic reports of successful results that are published and with a desire to determine the acceptability of the methods producing the results, basal sciences may be pushed temporarily into the background. In the background they are less easily discerned and effort is needed to bring them forward again. To care for results alone is not enough.

Current Comment.

PROCAINE PENICILLIN AND THE PROBLEM OF PENICILLIN ADMINISTRATION.

VARIOUS means have been suggested to overcome the disadvantage of frequent injections in penicillin therapy, the need for maintenance of an adequate blood concentration being kept in mind. One means, referred to in these columns on November 22, 1947, has been to delay the excretion of penicillin through the kidneys, an effect produced by "Caronamide". Further experience with "Caronamide" has, however, engendered a cautious attitude in those who have used it most. For example, M. Meads *et alii*[1] observed mild toxic effects in some of their patients with levels of "Caronamide" sufficient to bring about effective enhancement of penicillin concentrations in the serum; they refer to more severe reactions reported by other investigators and recommend that "Caronamide" should be used with caution until long term pharmacological studies in human beings are completed. "Caronamide" may cause renal damage, but this has not been proved. Another approach to the problem of penicillin administration has been to devise means of delaying its absorption from the site of injection. This has been achieved by suspending the penicillin in such substances as peanut oil (*Oleum Arachis*) or peanut oil and wax. The absorption is still further delayed, according to E. W. Thomas *et alii*,[2] when the penicillin is suspended in peanut oil gelled with aluminium stearates, which are water-repellent substances. Another important preparation in this field is procaine penicillin, a compound of procaine and penicillin, which seems to offer peculiar advantages. Thomas *et alii*, in the paper already cited, found that procaine penicillin in peanut oil gelled with 2% aluminium stearate of a small particle size maintained a particular blood concentration over a much longer period than the same combination but with penicillin of large particle size. An investigation of the administration of procaine penicillin has been reported recently by M. Y. Young, G. W. S. Andrews and D. M. Montgomery.[1] They refer to the difficulties of administration and the reactions associated with preparations of penicillin incorporated in a mixture of peanut oil and beeswax, which are effective from the point of view of delayed absorption. More conveniently administered, but otherwise inferior and productive of pain on injection, is a mixture of penicillin in ethyloleate and beeswax. Procaine penicillin in oil or water suspensions, with or without aluminium stearate, has been found to fulfil most of the conditions of an effective, slowly absorbed penicillin preparation, and it produces minimal discomfort on injection. Young and his colleagues gave injections of procaine penicillin, in oil, in water, and in oil combined with aluminium stearate, containing 300,000 units per millilitre, to 185 persons. Procaine penicillin G in oil with aluminium stearate was found to be superior to other preparations tested for the delaying of absorption of penicillin. It is pointed out that this is a stable preparation, easy to administer, that it causes no pain or undesirable side effects, and that, given in a dose of 300,000 units, it produced therapeutic blood penicillin levels for twenty-four hours in virtually 100% of cases. Oil and water suspensions of procaine penicillin, without aluminium stearate, in a dose of 600,000 units produced a therapeutic level at the end of twenty-four hours in 100% of cases; in a dose of 300,000 units they achieved this in only 50% to 60% of cases. A few patients received a single dose of 2,000,000 units of procaine penicillin with aluminium stearate in oil, and most of them had a therapeutic blood penicillin level for a week after the injection. As a logical development from this, by the use of a preparation of procaine penicillin in oil with aluminium stearate together with soluble penicillin, it was found possible to combine the advantages of rapid initial absorption and delayed action. In summary then it would seem that procaine penicillin G in oil with aluminium stearate is the most suitable preparation for clinical use when economy in material, slow absorption and a long-lasting therapeutic blood penicillin level are important; and the painful necessity for frequent injections is overcome.

There is probably no field in which these problems of penicillin administration are so important as the treatment of children, and procaine penicillin appears to have proved very useful. M. J. Carson, R. B. Gerstung and H. A. Mazur[2] treated a group of children with a proprietary preparation, "Duracillin, In Oil" (crystalline procaine penicillin G in oil) and report favourably on the results. A dose of 150,000 units was given to infants under eleven kilograms in weight, and 300,000 units to bigger children. Adequate therapeutic penicillin levels of 0·1 unit per millilitre were found in the serum of all patients studied twelve hours after the injection and in that of the great majority twenty-four hours after a single injection. The suggestion is made that the injection should be repeated each twelve hours if high serum levels are desired and each twenty-four hours if such high levels are not considered necessary. In the few cases in which frequent estimations of penicillin in the blood were made, it was found that peak levels were found within half to one hour after the injection. It is therefore unnecessary, these writers consider, to commence treatment with an initial dose of plain crystalline penicillin. Carson, Gerstung and Mazur point out the possibility that *p*-aminobenzoic acid may be produced from the procaine and that this may inactivate sulphonamides if these are being given concurrently with the procaine penicillin. No evidence of sensitization to penicillin, sesame oil or procaine was seen in their group.

[1] *The Journal of the American Medical Association*, November 20, 1948.
[2] *The Journal of the American Medical Association*, August 21, 1948.

[1] *The Lancet*, May 21, 1949.
[2] *The Journal of Pediatrics*, January, 1949.

One instance of sterile abscess formation occurred. This lack of generalized toxic reactions in children is contrasted with the reactions seen in a group of adults similarly treated; of these adults five out of 102 showed evidence of sensitization. In these cases "Pyrabenzamine" successfully relieved the allergic manifestations, and at a later date, when "Pyrabenzamine" was given prophylactically before injections of procaine penicillin, no allergic reactions were observed.

Another and more recent report comes from Edinburgh. W. M. Wilson, J. W. Farquhar and I. C. Lewis[1] administered a suspension of procaine penicillin G in arachis oil to children of various age groups. A single injection was given in each case, the dosage being graded according to the child's age. No reactions, either local or general, were encountered, and the injections were apparently completely painless. In babies a dose of 100,000 units produced therapeutic blood penicillin levels for at least twenty-four hours, and during the period immediately after birth the levels were maintained for considerably longer, a fact due, it is suggested, to the period of physiological dehydration which follows birth. Amongst older children a dose of 150,000 to 300,000 units produced therapeutic blood levels of penicillin lasting for at least twenty-four hours in 23 out of 29 cases. The question referred to by Carson, Gerstung and Mazur relating to the possibility of antagonism between procaine and sulphonamides is mentioned also by Wilson, Farquhar and Lewis. They suggest that, although the amount of procaine (120 milligrammes) in 300,000 units of procaine penicillin is theoretically enough to counteract a blood sulphonamide level of two milligrammes per 100 millilitres, the procaine is absorbed slowly over a period of twenty-four hours and the *p*-aminobenzoic acid formed from it is rapidly excreted in the urine, so that the amount of *p*-aminobenzoic acid present in the body is probably insignificant. However, the position requires further investigation and until it is clarified it may be as well to follow the advice of the authors of both these papers and to refrain from combining procaine-penicillin therapy with sulphonamide therapy; ordinary penicillin may still be used. For the rest, these reports provide in large measure the answer to the problem of frequent injections in penicillin therapy.

THE PHYSIQUE OF YOUNG MEN IN GREAT BRITAIN.

SWEEPING GENERALIZATIONS concerning the medical fitness and physique of nations and of particular sections of a community are sometimes made, but their validity must often be questioned because few reliable figures are available. Most of the sets of figures examined have had some important selective factor which makes them of little value in indicating the general state of affairs. One of the few exceptions to this resulted from the operation in Great Britain of the *Military Training Act*, 1939, which required every male British subject aged between twenty and twenty-one years and ordinarily resident in Great Britain to register for military training. Certain men were excluded from this group, but it is not thought that this fact was significant in modifying its representative character. Broadly speaking, there was no manpower reservation policy in 1939 and selection for call-up for medical examination was based merely on date of birth. After the outbreak of hostilities many selective factors came into play, as they did in relation to other sets of figures sometimes put forward; for example, the results of examinations in 1918, when the men examined were the residue of repeated examinations, or the results of examination of volunteers for the British Army in the early 1930's when the high proportion of rejections could well be explained by the very exacting standard demanded by the Army and the unpopularity of military service, which failed to attract the best type of men. However, the 91,513 men examined under the 1939 Act, the details of whose Medical Board records have now been presented in a report by W. J. Martin issued by the Medical Research Council,[1] can reasonably be regarded as representative of their age group. The medical records provided particulars of place of birth, nationality, age, trade, visual acuity without glasses, weight, height, chest circumference, medical grade, physical defects and medical history. The recording of the last-mentioned two items varied too widely to permit satisfactory analysis and Martin has omitted them, but many of the other details are of interest. The most important finding from the material analysed is expressed conservatively in the Medical Research Council's preface to the report:

> The material has been displayed so as to illuminate, wherever justifiable, questions of broad social interest and, in view of the pessimism excited by a report of the Ministry of National Service after the first World War, it should be said at once that the conclusions to be drawn from the present data, while wholly unsensational, are within their limits encouraging. The proportion of men assigned to medical grade I, the highest grade, is reassuring and was closely similar throughout the different parts of the country (though it must be remembered that the medical assessment of recruits on entry into the Services may not always have been substantiated by their further careers).

More specifically, 81·4% of the men were placed in Grade I and only 2·7% were placed in Grade IV (those unfit for any form of service). Eyesight was an important factor in determining the grade in which a recruit was placed; it was found that 65·9% had what Martin describes as perfect vision, a further 13·3% having perfect vision in one eye with an inferior second eye; almost 5% had seriously defective vision. For the whole country the mean weight was 135·7 pounds, the mean height 67·5 inches and the mean chest circumference 35·6 inches. A point of interest, as confirming a widely held belief, is that a higher standard of physique and lower incidence of defects was presented by the countryman in comparison with the town dweller, this finding being true for the country as a whole and for all individually considered parts of the country; the most striking difference related to standard of vision. A comparison of the mean measurements for Englishmen, Scotsmen and Welshmen provides no remarkable findings, but is doubtless of national interest, and slight as the differences are they may cause some surprise. The Scots were found to be, on the average, 0·2 pound lighter and half an inch shorter than the English; the Highlanders were, on the average, superior in weight and height to Scots of other regions. Compared with the average value for the whole of Great Britain, Welshmen were 1·7 pounds lighter, 0·4 inch shorter and equal in chest circumference. A finding that arouses speculation is the evidence that migrants from one part of the country to another were, on the average, of rather greater physique than the stay-at-homes. As is pointed out in the preface, this observation may have a bearing on the belief that migrants are drawn mainly from the physically fit, a differential movement which has in the past influenced the level of local death rates.

Many other details of this report might be mentioned, though much of it is of domestic interest only. However, the thought that inevitably arises is one of regret that no comparable set of figures is available in Australia, though the fault is primarily one of lack of opportunity. The value of the British report is pointed out in the comment that "no previous survey of young adults in this country [Great Britain] has collected equivalent data on such a scale, and the memorandum will be useful in providing a trustworthy standard against which future progress or deterioration may be measured". A similar report would have similar value in Australia. The results of medical examinations during the recent war are influenced by too many selective factors to provide a representative picture; but it is to be hoped that if in the future medical examinations are carried out in relation to any scheme of universal training, in peace time, they will be conducted and recorded with care and the findings analysed and made available for discussion and future reference.

[1] *The Lancet*, May 21, 1949.

[1] "The Physique of Young Adult Males", by W. J. Martin; Privy Council Medical Research Council Memorandum, Number 20; 1949. London: His Majesty's Stationery Office. 9¼" × 6", pp. 66. Price: 1s. 3d.

Abstracts from Medical Literature.

OPHTHALMOLOGY.

Corneal Transplantation.

R. TOWNLEY PATON (*American Journal of Ophthalmology*, November, 1948) discusses the selection of subjects for corneal transplantation. He states that each case must be dealt with individually, but in the study of the patient's eye condition the following factors must be considered: (i) environmental factors: for example, a patient whose visual acuity is less than 20/200 in either or both eyes but who is well adjusted to his environment and is self-supporting might better be left alone; (ii) age group: as a rule these patients belong to a younger age group than do cataract patients; transplantation is to be avoided in the very young because of difficulty in handling the patients; (iii) iridectomy: in no case should scarred cornea be operated upon if an iridectomy will improve vision. Subjects for operation may be classified as follows: (i) favourable for improvement in vision, (ii) partially favourable for improvement in vision, (iii) unfavourable for improvement in vision, (iv) suitable for cosmetic improvement, (v) suitable for treatment of descemetocele, (vi) those for whom preliminary surgery or treatment is necessary before final opinion may be given. In the first group the most favourable subjects are those with a nebulous opacity, central and in an otherwise normal eye. There must be no raised intraocular pressure and no vascularization of the cornea. Blood-staining of the cornea and conical cornea are usually favourable. For conical cornea graft should not be carried out if the visual acuity is better than 20/200 in either one or both eyes. In the second group are those with some corneal vascularization, as in old interstitial keratitis. If glaucoma is present a filtering operation should be performed first. In most cases of corneal dystrophy the prospects are unfavourable for operation, although with Groenouw's dystrophy a more favourable result is likely than with the others. In the third group are patients with nystagmus and densely scarred corneæ from powder burns. Transplantation for cosmetic purposes replaces the operation of tattooing. The author regards corneal graft as the most favourable treatment for descemetocele, but the degree of corneal vascularization should be one of the most important and determining factors. When there is extensive vascularization of the cornea preliminary irradiation should be performed.

The Surgical Treatment of Vertical Deviation.

JOHN N. DUNNINGTON (*American Journal of Ophthalmology*, November, 1948) discusses various operations and their indications in the treatment of vertical deviation due to paralysis of extraocular muscles. For paralysis of the superior rectus muscle one of three operations can be performed: strengthening of the affected muscle, weakening of the opposite inferior oblique or weakening of the inferior rectus of the same eye. The affected muscle should be strengthened when there is genuine limitation of motility in the field of action of the superior rectus, secondary overaction of the ipsilateral inferior rectus and fixation with the sound eye. It must be remembered that shortening of the superior rectus may be followed by a slight ptosis. For this reason the muscle should not be resected more than six millimetres. The opposite inferior oblique should be weakened when the limitation of motility of the affected eye is minimal and when fixation is maintained by the paretic eye. Weakening of the inferior rectus of the same eye is indicated when the primary condition is fibrosis of the inferior rectus, which simulates paralysis of the superior rectus. With paralysis of the inferior rectus the operative choice is strengthening of the affected muscle or weakening of the opposite superior oblique. The first is indicated in cases in which there are genuine limitation of motility in the field of action of the inferior rectus and fixation with the sound eye. Weakening of the opposite superior oblique is indicated in those cases of paralysis of the inferior rectus in which fixation is maintained by the paretic eye. For paralysis of the superior oblique the affected muscle is strengthened, the opposite inferior rectus is weakened or the inferior oblique of the same eye is weakened. Strengthening of the affected muscle is indicated when there is limitation of motility in the field of action of the superior oblique and fixation with the sound eye. Where limitation of motility is slight and fixation is maintained with the paretic eye, as is seen after radical sinus surgery, recession of the inferior rectus of the opposite eye often produces a gratifying result. Recession should not exceed two to three millimetres. Weakening of the inferior oblique of the same eye is the operation of choice when this muscle shows definite overaction, that is, a secondary spasm. Paralysis of the inferior oblique rarely causes discomfort and is best left alone. However, if surgery is contemplated, the affected muscle may be strengthened or the superior rectus of the opposite eye may be weakened.

Retrolental Fibroplasia in Premature Infants.

WILLIAM C. OWENS AND ELLA U. OWENS (*American Journal of Ophthalmology*, January, 1949) have traced the origin and development of retrolental fibroplasia. They state that in the fully developed case an opaque vascularized membrane lies against the posterior surface of the lens. The globe is often smaller than normal, the anterior chamber is frequently shallow, and occasionally posterior synechiæ form. Elongated ciliary processes, appearing like coarse teeth of a comb, can be seen behind the iris on the membrane in the extreme periphery of the dilated pupil. In premature infants both eyes are usually involved, but not always to the same extent. In some eyes the retrolental membrane may be incomplete and cover only a localized portion of the retrolental space. In others the membrane may be limited to the periphery of the anterior part of the vitreous body at the equator of the lens. In these cases a localized detachment of the retina often extends into the membrane. The authors examined 214 premature infants born in the period from July, 1945, to June, 1947. All infants weighed 2000 grammes or less at birth and none had retrolental fibroplasia at birth. All were observed for six months. The disease was found to develop in nine cases. The earliest detectable abnormality was slight dilatation of the retinal arteries and veins. The dilatation gradually increased, but was greater in the veins, which increased to about three times their normal size. As the vessels increased in size they became tortuous. The changes in the vessels were followed by the appearance of one or more small greyish-yellow elevations of the retina in the far periphery. Soon the margin of the disk became blurred and generalized retinal œdema developed. The greyish masses increased in height and other greyish-yellow masses appeared scattered throughout the fundus. After a short time a grey membrane with numerous vessels coursing over it billowed forward in folds at the periphery of the retrolental space. At this stage the fundus could be only hazily seen. Bands of tissue extended from areas of detached retina into the vitreous body. Finally, a complete retrolental membrane was formed by gradual extension and fusion of the peripheral folds of the retina. Broad ciliary processes were seen extending onto the membrane at its periphery and numerous vessels were present on the surface of the membrane. The diameter of the cornea was usually smaller than normal. Some eyes showed secondary changes with the development of glaucoma. Occasionally the course of the disease was arrested at some stage in its progress. In no case did a retrolental membrane develop after five and a half months of postnatal life. Various hypotheses concerning the ætiology of retrolental fibroplasia are suggested; these are at present being investigated.

Unusual Mycotic Infection of Lachrymal Canaliculi and Conjunctiva.

H. C. DONAHUE (*American Journal of Ophthalmology*, February, 1949) reports an unusual case of mycotic obstruction of the lachrymal canaliculi with involvement of the palpebral conjunctiva. A child, aged twelve years, reported with epiphora and discoloration of the inner aspect of the lower lid of the left eye. A tiny incision was made in the black substance in the lower punctum and pressure was exerted in the tear sac region. A sticky, tenacious, molasses-like fluid was expressed, with complete disappearance of the brownish-black discoloration of the conjunctiva. The material expressed was investigated by examination of a direct smear and by culture. By both methods the fungus *Aspergillus niger* was demonstrated.

An Advocacy of External Dacryocystorhinostomy.

F. N. SHUTTLEWORTH (*The British Journal of Ophthalmology*, March, 1949) analyses the results in 60 cases of external dacryocystorhinostomy performed between October, 1941, and December, 1947. Two methods were employed. In the first the sac and periosteum of the anterior lachrymal crest and fossa are displaced laterally. The bone of the floor of the fossa and lower part of the anterior lachrymal crest down to the level of the inferior orbital margin is removed. The nasal mucous membrane exposed is cut on three sides to form a flap, the intact

side being anterior. The medial wall of the sac is removed and the flap of nasal mucous membrane is turned forwards and sutured to the sac over the entrance of the canaliculi. The duct is syringed on the fourth day. In the second operation the anterior lachrymal crest is removed by means of hammer and chisel, the floor of the fossa with Duprey-Dutemps forceps. The mucous membrane exposed is incised to produce a flap with its base hinged posteriorly. The lachrymal sac is incised to produce a similar flap hinged anteriorly. A rubber tube is inserted via the nose and its end lies between these two flaps. The tube is held by a silk stitch, which is tied on the surface. The anterior flap is sutured to the inner end of the internal palpebral ligament. The tube is removed via the nose on the seventh day. The results were equally good with either method, and good results were obtained by less experienced operators.

LARYNGOLOGY AND OTOLOGY.

Surgery of the Chronically Discharging Ear.

HOWARD P. HOUSE (*Archives of Otolaryngology*, February, 1949) states that in the surgery of the chronically discharging ear the approach is made through a modified endaural incision. Entrance to the mastoid antrum is made by means of a penetrating burr, as in the Lempert fenestration procedure. The point of entry is directly below a line carried horizontally backwards from the superior margin of the external auditory canal and directly behind a line directed superiorly from the posterior margin of the canal. The burr is placed at right angles to the patient's skull and must never penetrate for a greater depth than the cutting portion of the burr. The mastoid cells are exenterated by means of cutting burrs of various sizes. The nearer one is to the lateral sinus or dural plate, the larger should be the burr. A large burr is used to thin the posterior bony ear canal wall down to a width of one or two millimetres. With exposure up to the dural plate and forward thinning of the posterior canal wall, the posterior portion of the horizontal semicircular canal is rendered visible in line with the superior wall of the auditory canal. A small burr is then used to uncover the zygomatic cells, the surgeon working from behind forwards and from within outwards, so that a thin shelf of cortical bone is exposed which forms the outer wall of the epitympanum. Probing of the aditus is unnecessary and may result in dislocation of the incus if attempted. This completes the simple mastoidectomy. The modified radical mastoidectomy is a continuation from the procedure just described. The thin bony plate overlying the epitympanum is carefully removed with a small curette, care being taken to avoid disturbing the incus. The head and neck of the malleus are thus exposed. The membranous ear canal is carefully separated from the postero-superior bony canal wall and the bony wall is removed down to the annulus. Further separation of the membranous canal is completed with a narrow Lempert elevator, which must be made to hug the bone very closely so that the membranous canal is not torn. With a fine rongeur the remaining bony ridge is bitten through, again with avoidance of injury to the incus. The epitympanum and its contents are now fully exposed to view. With magnification and adrenaline to provide a bloodless field, all granulations and cholesteatoma are carefully removed. A small eye spud and gentle suction are used in this process. If necrosis in the osiscular chain is found, then the incus and head of the malleus are removed. If the epitympanic pathological tissue is satisfactorily removed, no flap is necessary and the incisions may be sutured. When radical mastoidectomy is planned it is essential for the surgeon to identify the Fallopian canal before entering the middle ear. The facial nerve is less likely to be injured if steps are taken to identify it rather than if its approximate site is avoided altogether. Diseased tissue may also be overlooked about this area. The thickened periosteum with all overlying pathological tissue is elevated in a posterior to anterior direction, the contour of the horizontal semicircular canal being followed to its anterior extremity, and then the small ring curette is directed inferiorly over the cochleariform process into the middle ear. If one enters the middle ear before reaching the anterior extremity of the horizontal canal, the stapes may be dislocated. As soon as the cochleariform process is exposed to view the entire Fallopian canal is clearly visualized. The cochleariform process is fractured in a direction away from the Fallopian canal. The *tensor tympani* muscle is then removed. All diseased tissue may now be removed from the middle ear. Infected granulations may be located in the stapes area. These can be removed with little risk if one works from behind forwards above and below the stapedius tendon and stapes. If the surgeon can be sure that all infected tissue has been removed the cavity may be left without epithelial covering and thus be encouraged to become obliterated by fibrosis. If a flap is required the skin of the auditory canal is turned back from the antero-superior canal wall to lie over the facial ridge and to epithelialize the mastoid cavity. A small graft also may be taken from the post-auricular area if necessary.

Ménière's Syndrome and Vitamin Deficiency.

MILES ATKINSON (*Archives of Otolaryngology*, February, 1949) states that a disturbance of vascular function has been proffered as the factor producing labyrinthine upsets in his previous writings and now records clinical evidence in support of a thesis that one factor, and perhaps the essential one, influencing these disturbances is a vitamin deficiency. He states that subjects of Ménière's syndrome may experience two distinct types of vertigo, rotational and positional, which have been found to be associated with different and specific vitamin deficiencies. In the former type there is a sensation of rotation associated with nausea and vomiting, while in the latter there is lateral or vertical movement of objects, in more severe cases having the effect of a sudden knock-down blow, but not usually associated with vomiting. The patients who experience rotational vertigo alone show signs of nicotinic acid deficiency in the tongue, give a small response to histamine injected intradermally and can be relieved of their attacks with nicotinic acid. Those patients who experience positional vertigo alone show signs of riboflavin deficiency in the tongue, the eyes and the skin, give a large response to histamine injected intradermally and can be relieved of their attacks with riboflavin. Those patients, the majority, who experience both kinds of vertigo, show signs of deficiency of both fractions, give an intermediate response to histamine injected intradermally, and require exhibition of both nicotinic acid and riboflavin. Other symptoms, common in patients with Ménière's syndrome, can be related to other deficiencies, such as the fatigue, irritability and palpitations associated with thiamine deficiency, and can be relieved by administration of the appropriate vitamin. Successful treatment may require large dosages of the appropriate substances, but increase should be gradual. Control may not occur immediately and relapses in the early days of treatment may be expected. A gradual diminution of the frequency and severity of attacks is to be anticipated, and relapse is to be regarded as an indication for more intensive treatment rather than for despair. The method adopted has been to start with small doses given parenterally and orally and to increase the doses slowly until acute symptoms are controlled. Nicotinic acid, increasing in dosage up to 50 milligrammes, is given intravenously each day for two weeks, thence 75 milligrammes intramuscularly each day for a month. With this 150 milligrammes may be taken daily by mouth and this dosage continued after the intramuscular injections are stopped. Riboflavin, commencing in dosage with 10 milligrammes each day by intravenous injection, is combined with an oral dosage of 40 to 120 milligrammes daily. Thiamine is given in daily doses of 25 to 150 milligrammes by injection and 40 to 400 milligrammes by mouth. With mixed deficiencies the same dosages may be given in combination.

Antro-Choanal Polypus.

A. R. DINGLEY (*The Journal of Laryngology and Otology*, March, 1949) states that antro-choanal polypus is a clinical entity differing widely in behaviour, origin and pathology from the more common nasal polypus. The presence of such a polypus, which may be invisible without posterior rhinoscopy, can cause severe obstruction to breathing. The polypus is almost invariably single. Its origin is in the maxillary antrum, where it is likely to be attached by a stalk on the posterior wall behind the accessory ostium or on the outer antral wall. The polypus may be firm and solid or of cystic structure. There is a mild catarrhal state, which rarely proceeds to suppuration. There is unilateral nasal obstruction gradually becoming more complete. A very large polypus may obstruct both nasal passages. Simple removal by snare through the nose without opening of the antrum is likely to be followed by recurrence. The Caldwell-Luc operation is preferred. The point of attachment is thus able to be detached and other antral disease is able to be dealt with. Complete stripping of the mucosa is rarely necessary. An antro-nasal opening may be made if this seems necessary for subsequent drainage, but may not be required when the accessory ostium is large, as it often is.

British Medical Association News.

ANNUAL MEETING.

THE seventh annual general meeting of the Australian Society of Anæsthetists (British Medical Association) was held on August 16, 1948, at the University of Western Australia, DR. R. H. ORTON, the President, in the chair. There was a full attendance of Western Australian members; fifteen members from other States were present.

Annual Report.

The annual report for 1947-1948 was presented and adopted. It was concerned mainly with the following matters. (i) Negotiations with The Royal Australasian College of Physicians and the Royal Australasian College of Surgeons relative to the establishment of a federal diploma in anæsthesia, to supersede the diplomata already being granted by certain of the State universities. Mention was made of the absence of machinery by which the two Royal Colleges referred to might set up a conjoint board for that purpose. (ii) The technical difficulties encountered by the newly formed committee on standards in drafting criteria of use to manufacturers of anæsthetic apparatus. (iii) The desirability of convening a committee on education, to further negotiations with the two Royal Colleges mentioned, and to introduce if possible some degree of uniformity into post-graduate education in anæsthesia in the various States.

Finance.

The treasurer's report for 1947-1948 was presented and adopted. The balance sheet, which is published herewith, shows the financial position of the society to be sound.

The curator of the library and museum gave an account of the expenditure of the funds allocated to him in the years 1947-1948, the funds being a great part of the total income of the society. He said that they had served to establish a library that was already comprehensive, and a technological museum which played a definite role in education.

Draft of a New Constitution.

The draft of a new constitution was then read to the meeting. It was pointed out that the new constitution was designed to replace the original constitution of 1935, from which it differed in several respects. The major difference lay in the proposed establishment of sections in the various States, the sections to have considerable autonomy in local affairs, whilst remaining under the general direction of the federal executive of the society. The finance of the State sections was to be met by a return by the executive to local treasurers of a portion of the annual subscriptions derived from the various States. The new constitution having been approved by the meeting, it was decided to submit it to a referenduum of all members.

Retiring President's Address.

DR. R. H. ORTON (Victoria), the retiring President, paid tribute to the support which he had received from the secretary, treasurer and other officers during his term of presidency. He described the activities in which the presidential office had involved him in the past year; among these were lectures before the Royal Australasian College of Surgeons in both Melbourne and Sydney, and an official visit to the congress of the New Zealand Branch of the British Medical Association in Dunedin. He cited those activities as illustrating the rising status of anæsthetists, which had already achieved the establishment of a faculty of anæsthesia within the Royal College of Surgeons of England. Dr. Orton then delivered an address entitled "The Surgeon-Anæsthetist Relationship" (see page 239).

Election of Office Bearers.

The election of office bearers for the year 1948-1949 was then held. Dr. E. R. Beech (Western Australia) was elected President and assumed office forthwith. Dr. D. G. Renton (Victoria) was elected Vice-President. Dr. J. Watson (Victoria), Dr. T. P. Crankshaw (Victoria) and Dr. G. Kaye (Victoria) were reappointed to their respective posts of secretary, treasurer, and curator of the library and museum.

Place of Next Meeting.

It was decided that the eighth general meeting in 1949 should be held at Melbourne.

The Intravenous Use of Procaine.

DR. IVAN SCHALIT (New South Wales) read a paper entitled "The Intravenous Use of Procaine" (see page 241). At the conclusion of his paper, Dr. Schalit reported that, in the three weeks since it had been compiled, he had added fifteen cases to his series and encountered one case of convulsions. The patient was a man, suffering from a perforated gastric ulcer. He was in great agony and required to be given one-quarter of a grain of morphine intravenously in the ward. Soon afterwards a further half-grain had to be given, also intravenously. When brought to the operating theatre, the patient was still in great pain. Dr. Schalit therefore gave an intravenous instillation of 30 millilitres of 0·5% solution of procaine, without thiopentone or "Nembutal", which drugs might be regarded as having an anti-convulsant action. Convulsions soon developed. Dr. Schalit immediately gave two millilitres of a 5% solution of thiopentone, with a further millilitre for good measure. The convulsions ceased, the administration of procaine was discontinued and anæsthesia was effected with a mixture containing one part of oxygen and three parts of nitrous oxide. The operation was performed without incident and the patient made a good recovery.

DR. R. V. PRATT (Western Australia), in opening the discussion on Dr. Schalit's paper, said that Dr. Schalit had given an interesting account of his personal experiences with what might yet prove to be a major advance in modern anæsthetic methods. The intravenous use of procaine could hardly yet be regarded as being beyond the experimental stage in the field of anæsthesia. As Dr. Schalit had remarked, relevant literature was conspicuous by its comparative scarcity, and such a paper was in consequence all the more valuable. Dr. Pratt went on to say that the anæsthetists' prime consideration in seeking newer and better agents, and that which prompted their present interest in the extended use of procaine, was the attainment of better anæsthesia, with all that it connoted. In view of what he regarded as a reversal of the old-time patient-anæsthetist relationship, he sometimes wondered if they were wise to look for still better methods than they at present possessed. Today, the patient by the end of the operation frequently was conscious, comfortable and conversational, the anæsthetist at that stage being commonly collapsed, if not from pumping the bag, then from the Herculean efforts of transporting a monstrously ponderous armamentarium. With the modern trend towards early ambulation (which they

AUSTRALIAN SOCIETY OF ANÆSTHETISTS (BRITISH MEDICAL ASSOCIATION).

Statement of Accounts as at August 7, 1948.

	£ s. d.	£ s. d.
To Presentation Tankard (Adelaide)	2 11 6	
„ Library	150 0 0	
„ Typing	14 14 9	
„ Stencilling	1 5 0	
„ *The British Journal of Anæsthesia*	2 12 2	
„ Photograph	1 12 6	
„ Duplicating	1 0 0	
„ Subscriptions to Journals	5 15 0	
„ Bank Charges and Exchange	1 8 6	
		181 0 5
„ Credit Balance—		
Credit as per Bank Statement, August 3, 1948	51 13 7	
Cheques not yet Cleared	6 16 11	
		58 10 6
		£239 10 11

	£ s. d.
By Balance at Bank at April 15, 1947	141 15 8
„ Subscriptions *et cetera*	97 15 3
	£239 10 11

themselves appeared to have made possible), they might one day find their patients visiting them on the first post-operative day, while they (the anæsthetists) lay exhausted on their convalescent couches.

Dr. Pratt then mentioned some of his own experiences and impressions in the intravenous use of procaine. His series to date was very small, but nevertheless the results seemed worth mentioning. In every case procaine had been used throughout the anæsthesia as an adjuvant to other anæsthetic agents, and all administrations had been carried out on private patients. In every case the anæsthetic procedure in general was carried out along the following lines. Procaine was added to a litre flask of glucose-saline solution, and a continuous drip infusion was commenced from the outset via an arm vein or the external jugular vein. Two syringes containing respectively thiopentone and curare were in every case connected by two-way taps to the infusion tubing, and fractional amounts of those drugs were injected into the "flow" as required both for induction and for maintenance. A constant background of nitrous oxide and oxygen was maintained, the carbon dioxide absorption technique being used and a constant flow of 500 millilitres of each gas per minute being kept going. In the earlier cases, the technique recommended by Professor Ralph Knight, of Minneapolis, was followed closely, but later some modification automatically followed, as one of the effects of the procaine was to reduce the amounts needed both of curare and of thiopentone. While the routine adoption of such a technique might sound rather too elaborate and time-consuming for private practice, it was not really so once the necessary equipment was streamlined for simplicity. Nor was it so with even one further addition; he (Dr. Pratt) had recently obtained from a Melbourne firm a flowmeter tube of the rotameter type to measure the infusion flow in millilitres per minute, and he hoped in all subsequent cases to measure the rate of procaine administration both for the improvement of control and to provide a more accurate record of the anæsthetic technique. With such a set-up he had begun using procaine first in minute amounts, such as 40 and 100 milligrammes, and as confidence was gained he gradually increased the total amount of procaine to 0·5 gramme, then to one gramme, and later to two grammes. In the fifteen recorded cases, four patients were males and eleven females. Their ages ranged from twenty-two to sixty-five years. Some were "good risks", some only "fair", and some "poor". Weights ranged from six stone one pound to thirteen stone. Operations included cholecystectomy, hysterectomy, radical mastectomy, gastrectomy, prostatectomy, ventral hernia repair, and miscellaneous intra-abdominal operations. The operation times ranged from fifty minutes to two and a half hours. The total amounts of procaine varied from forty milligrammes to two grammes, and the concentrations ranged from 0·01% to 0·2%. In thirteen cases anæsthesia was completely smooth and satisfactory, while there was one case of mild bronchospasm occurring after each small addition of curare (which, incidentally, seemed to settle down quite quickly with the intravenous injection of an anti-histaminic drug), and there was one case of bradycardia due it seemed to a preexisting bundle defect. Dr. Pratt said that in regard to the last-mentioned patient, he could not see that procaine was responsible, as, being one of the first patients, she received only 100 milligrammes of procaine over a period of one and a half hours and had shown similar arrhythmia many weeks before operation. In two cases, a drip administration of procaine was continued post-operatively for a short time. The blood pressure records did not seem to be informative, possibly owing to the smallness of the series; at all events, there was a final rise in systolic blood pressure in some cases and a fall in others. The trend of the pulse pressure also showed a rise in some cases and a fall in others, although in all cases the diastolic pressure either rose or remained stationary—it never fell. When one gramme or more of procaine was used, thiopentone requirements varied from 0·325 to 1·0 gramme, and the amounts of curare varied from 20 to 46 milligrammes. The requirements for thiopentone in the more recent cases had ranged from 0·3 to 0·6 gramme for operations lasting one and a half hours. The post-operative results had been most gratifying. Twelve patients were without any apparent adverse effect, two showed a reduction in pulse pressure for several hours, and one manifested unexplained attacks of tachycardia with dyspnœa a day or two later; the last-mentioned patient was the one who had shown the pre-operative arrhythmia already referred to—the effect of procaine appeared to be irrelevant. The post-operative requirements of morphine were much reduced for nearly all patients. Some did not require any injections during the first twelve hours, others required no more than one or two for the whole post-operative period, and a few were given as many as three or four during the first twenty-four hours. Vomiting was either absent or of negligible degree in most cases. Dr. Pratt said that what had impressed him particularly was the brightness and the volubly expressed well-being demonstrated by practically every patient and commencing usually on the first or occasionally on the second post-operative day. One of his most recent patients, a woman, aged thirty-nine years, undergoing cholecystectomy, had gone so far as to laugh and joke about the bottle of gall-stones by her bed less than two hours after their removal; she said also that she felt comfortable and completely free from nausea.

Dr. Pratt then referred in some detail to the case of a man, aged thirty-nine years, a "fair risk" patient, weighing eleven stone seven pounds, who had undergone gastrectomy and removal of a duodenal ulcer. The patient had a chronic cough and sputum, and a history of previous post-operative pulmonary embolism. Premedication consisted of "Nembutal", one-sixth of a grain of morphine, 1/150 of a grain of atropine and 1/200 of a grain of hyoscine. Anæsthesia was conducted as previously described with thiopentone, procaine (1/1000 in 4% glucose solution and one-fifth normal saline solution) and a nitrous oxide-oxygen mixture, with curare. For the operation period of two and a half hours, the total requirements were 0·75 gramme of thiopentone and 40 milligrammes of curare. During that time 1·5 grammes of procaine were given. The patient's condition throughout was excellent; he had a steady and constant blood pressure of 150 millimetres of mercury (systolic) and 110 millimetres (diastolic) and a pulse rate which stabilized itself at 88 per minute. A further 0·5 gramme of procaine was given for an hour or so after his return to bed (the majority of the patients were awake and conversational on their return to bed). He was given four injections of morphine that day, although it was doubtful whether they were really required; they were more likely to have been given by the staff as "routine treatment". At all events, no further injections were needed, and on the following day the patient greeted Dr. Pratt with an ear-splitting smile and practically leapt out of bed to prove his assertions of well-being.

Dr. Pratt then said that a perusal of some of the contributions to the literature on the subject, such as the work of F. M. Allen, C. Burstein and K. A. Kraft, would seem to establish three main advantages for the intravenous use of procaine in anæsthetic practice: (i) in preventing and in treating cardiac irregularities; (ii) in allowing a reduction in the amount of other agents used, such as cyclopropane, thiopentone and spinal anæsthetic drugs, and thus in particular benefiting the "poor risk" patient; (iii) in greatly reducing post-operative pain and also the number of opiate injections required. Such limited experience as he had had, had left him with the impression that those advantages did in fact exist, and to a significant degree. In addition, he had also the impression that an additional advantage might be found—namely, in the apparent increase in well-being already remarked upon in many of the patients. In fact, to his mind that alone seemed adequate justification for giving the agent further consideration and trial. It was interesting to notice the large amounts of procaine given by Allen and his co-workers. For example, he quoted one case (a cholecystectomy) in which induction with 3·75 grains of "Sodium Amytal" was followed by anæsthesia maintained solely by a "procaine drip"; 4·25 grammes of procaine were administered over a period of one and three-quarter hours. Allen also mentioned having given up to eight grammes and more per day for relief of pain in certain very painful conditions. K. A. Kraft had summed up the complications of the intravenous use of procaine as falling under two headings—those referable to the central nervous system and proceeding to convulsions, and those referable to the circulatory system and manifested as a state of collapse. Kraft stated that the severity of the symptoms would be related to the sensitivity of the patient to paraaminobenzoic acid, and to the amount, rapidity of injection and concentration of the procaine solution. He advocated the use of thiopentone in the treatment of those complications. Dr. Pratt said that since reading Kraft's article he had adopted the practice of adding 0·25 gramme of thiopentone to each litre of procaine-saline solution. It was also suggested that procaine sensitivity might increase with depletion of the vitamin *C* content of the tissues, and with general derangement of the fluid balance and nutritional status of the patient. Dr. Pratt finally said that those mentioned were only a few of the many possibilities opened up by the recent use of procaine as an intravenous anæsthetic agent. There were others not yet touched upon. He hoped that some of those present would be stimulated and encouraged by Dr. Schalit's paper to explore some of those fascinating possibilities.

Dr. Pratt also demonstrated his apparatus for the intravenous administration of procaine. It consisted of a standard

"Soluvac" stand, with a hook to support the flask. A clamp carried two syringes, one of two millilitres' capacity for curare and the other of twenty millilitres' capacity for thiopentone. The syringes were attached to a two-way stopcock. A second clamp supported an arm rest of wire. A flowmeter of the "rotameter" type, calibrated for a liquid, was inserted in the delivery tube from the flask, between it and the intravenous needle, but proximal to the inlet from the syringes. By means of this flowmeter, the rate of flow of the procaine-saline solution could be more accurately controlled than with a conventional drip-feed.

DR. S. V. MARSHALL (New South Wales) said that the intravenous use of procaine seemed at first sight to be an alarming novelty. However, there appeared to be something to it. The manner of action of procaine was suggestive of "Myanesin"; indeed, it might well be that "Myanesin" had everything to fear from the competition of procaine. In the case in which Dr. Schalit inadvertently gave a 2% solution, convulsions were to have been expected, and it was interesting that they had not occurred. It was difficult to assess the value of procaine if it was given with curare or other drugs; Dr. Schalit, however, seemed to have utilized adequate controls, and his further results were awaited with interest.

DR. G. TROUP (Western Australia) said that he had only once used procaine in the operative stage, the case being one of pericardectomy; the patient died upon the operating table. The heart went into a condition of ventricular fibrillation whilst being handled surgically, and efforts to reinitiate contractions by means of massage were fruitless. Procaine should, in theory, have militated against fibrillation; but perhaps the dosage was too small. Dr. Troup had used procaine post-operatively in a series of cases of thoracotomy. He adhered to the "procaine unit dosage"—approximately 250 milligrammes dissolved in saline solution and given by the drip method over a period of twenty minutes. On that dosage, the degree of relief from pain seemed to be less than might have been secured by pethidine, morphine or "Omnopon". Dr. Troup asked to what extent it was justifiable to exceed the procaine unit dosage.

DR. A. L. B. WEBB (Victoria) asked Dr. Schalit, who had said that procaine gave muscular relaxation, to what extent it compared with curare. Dr. Webb said that in Dr. Pratt's cases the relaxation came obviously from the curare given with the procaine. He expressed sympathy with Dr. Troup in his fatal case of pericardectomy. In such cases he (Dr. Webb) kept swabs of procaine solution at hand, but he had so far not needed them. In his small experience, cardiac irregularities had occurred only when the pericardium was being stripped down the interventricular septum. In his future cases he would always have at hand a procaine "drip" apparatus in preference to swabs.

Dr. Schalit, in reply, said that with any new technique the watchword should be "safety". He had been present at the Royal Society of Medicine when Halton and Gray delivered their first report upon curare. They were berated by one speaker for basing their report on so small a series—namely, something over 1000 cases. By that standard his series with procaine was insignificant, and he did not advocate light-hearted use of the drug in the manner described. Dr. Pratt's cases suffered from the use of so much curare, which made it difficult to assess the value of the procaine. In his earlier essays, Dr. Schalit had selected the fitter patients for the method, but he had gained confidence in its use. As a curiosity, he mentioned the administration of three millilitres of a 0·5% procaine solution to a baby, aged three weeks, the indication being that a blood transfusion declined to flow. In reply to Dr. Marshall, Dr. Schalit said that unless "Myanesin" was equivalent to 3% or 4% procaine solution, it could not act in a similar manner. His own conception was that procaine acted by laving the muscles and not by blocking the nerves; but he had no exact knowledge about it. Like Dr. Troup, he questioned whether the efficacy of procaine in relieving post-operative pain was equal to that of morphine. If procaine was to be used as a routine under hospital conditions, as in Dr. Troup's hospital, the dosage should be less than the procaine unit dosage. Dr. Schalit suggested an initial 10 millilitres of a 0·5% solution, followed by a 0·1% solution flowing at the rate of 40 drops per minute. In answer to Dr. Webb, Dr. Schalit said that the relaxation secured from procaine in upper abdominal operations seemed to be as good as that yielded by curare. Procaine should prove helpful in plastic operations once the original incision into the skin had been made. He drew attention once again to the "selective" action of the drug upon traumatized tissues. Dr. Schalit concluded his remarks with a final reminder that the safety of the intravenous administration of procaine was still unproved.

The Relaxing Agents.

DR. S. V. MARSHALL (New South Wales) read a paper entitled "The Relaxing Agents" (see page 245). He also showed the film "*d*-Tubocurarine Chloride" made available by courtesy of Burroughs Wellcome Limited.

DR. A. L. B. WEBB (Victoria), in opening the discussion, said that his experience has been almost wholly with tubocurarine, apart from some early use of "Intocostrin". He had not felt inclined to use "Myanesin", owing to diverse reports upon its relaxing power and because of its known inability to suppress laryngeal reflexes. His uses for curare fell into five categories: (i) as an aid to tracheal intubation; (ii) as a relaxant of the abdominal musculature; (iii) as a means of preventing injury in electric convulsant therapy; (iv) in orthopædic surgery; and (v) in thoracic surgery. Dr. Webb deprecated the use of curare as an aid to tracheal intubation, except in rare cases of fractured jaw or pedicle implantation in which a quiet induction was particularly desirable. Even then, curare should be used only if all mechanical facilities for control of the respiration were at hand. The use of curare in abdominal surgery had proved revolutionary, but was too familiar to merit comment. He was undecided as to the best supplement at the stage of closure of the abdomen, but tended towards ether as proposed by Dr. Marshall. Full control of respiration should be instituted at that stage so as to suppress the effects of expiration, which was an active and not a passive phenomenon at a light plane of anæsthesia. It therefore tended to extrude the bowel from the abdomen and hinder closure, a point established by Dr. John Watson at the meeting of the society in Adelaide in 1947. Control of respiration, by removing the need for active expiration, ensured for the surgeon a quiescent abdomen for closure, despite the light plane of narcosis.

Dr. Webb's experience of curare in electric convulsant therapy was limited to perhaps ten cases. He had noticed great variation in the effects produced in different patients. Thus, two women of like weight each received a similar dose of hexobarbitone and curare; in one, the electric convulsion was pronounced, in the other it was practically imperceptible. He agreed with Dr. Marshall that the electric shock seemed to nullify the effect of the curare, since recovery occurred far more rapidly than it would in a surgical patient who had received the same dosage. Dr. Webb gave warning against light-hearted use of curare with thiopentone for orthopædic manipulations; if the alkaloid was used, facilities for controlled respiration must be at hand.

Dr. Webb went on to say that it was perhaps in thoracic surgery that curare had its greatest value. In thoracoplasty, the straining and laryngeal spasm which so often accompanied apicolysis could be controlled by previous administration of curare, anæsthesia still remaining light. In endothoracic operations there should be no great hurry to proceed to intubation; one should wait for three minutes if possible before intubating the trachea. Dr. Webb said that in sixty major thoracic procedures, he had successfully employed Dr. Orton's procedure of giving the initial calculated dose of curare and following it up with subsequent doses at intervals of approximately half an hour, the supplementary doses being one-third the size of the first. He mentioned the well-known danger in cases of intestinal obstruction, whether curare was used or not—namely, that a flood of intestinal contents might be regurgitated into the pharynx before the cuffed endotracheal tube could be placed in position. An analogous condition might be met in thoracic operations. Anæsthesia might be induced with thiopentone and curare; but before intubation could be effected, a flood of secretion from the diseased lung might invade the pharynx. That was more likely if induction took place with the patient in the lateral posture, the diseased lung being uppermost. For that reason, anæsthesia in the presence of copious pulmonary secretion should be induced with the patient in the dorsal decubitus. In cases in which the cyclopropane-curare combination was used, spasmodic contractions of the diaphragm might occur, usually because anæsthesia was unduly light. However, they might occur apparently spontaneously. Ether supplement might control them, as might the intravenous administration of pethidine suggested by Dr. Marshall.

Dr. Webb, in conclusion, emphasized the fact that relaxants were admirable for trained anæsthetists, but were unfortunately urged upon general practitioners by the drug houses. Even specialists abused those drugs. They sometimes left the patient before the effect of curare had wholly abated, or failed to maintain proper ventilation of the lungs during the administration. Disasters had therefore occurred; indeed, the Coroner's Surgeon of Melbourne was perturbed about their frequency. In general, the simplest anæsthetic method which would do the work was the method of choice.

The patient's welfare was the primary consideration. Indiscriminate use of relaxants was apt to lead the anæsthetist along the path of complexity and of danger.

DR. R. H. ORTON (Victoria) quoted work done by Associate Professor Shaw in Melbourne, who had checked Cullen's work on the toxic dosage of "Intocostrin" and found it not to apply to tubocurarine; indeed, with the latter drug, the toxic dose was more than 1000 times greater than the paralytic dose. Some workers barred the use of curare in renal or hepatic disease, but Shaw found the curare effect to pass off almost as quickly in animals deprived of liver or kidney as in normal animals. It seemed, then, that curare, like thiopentone, was largely destroyed in the blood.

Dr. Orton went on to say that he had used curare in 400 major thoracic operations. He had not seen serious ill-effects from its use. He used thiopentone and tubocurarine for induction as a routine, but they were not the dramatic aids to tracheal intubation which they were first thought to be. When the larynx was exposed, the vocal cords were often found to be adducted. However, the tube could usually be pushed gently between them into the trachea, without exciting the spasm which would occur in the absence of curare. The drug was undoubtedly a saver of time in intubation, but should not be given in large dosage for that purpose. Dr. Orton said that whilst he used curare readily for bronchoscopy, he did not like it for œsophagoscopy, unless an endotracheal tube was passed and facilities were at hand for manual aid to respiration in an atmosphere of oxygen. In bronchoscopy, the insufflation of a stream of oxygen into the bronchoscope would usually provide adequate ventilation for the patient under curare. The difficulty with endoscopy under curare was that the procedure was often short, ending before the curare effect had abated. It then became necessary to insert an endotracheal tube, if one was not already in use, and to ventilate the lungs with oxygen. The patient might have to be returned to bed with that tube in position; but it was imperative that he be not left by the anæsthetist until effective spontaneous ventilation had been recovered. For those reasons, Dr. Orton reserved curare in endoscopy mainly for tuberculous patients, in dealing with whom it was most important to avoid coughing and consequent dissemination of secretion through unaffected areas of lung.

DR. G. TROUP (Western Australia) said that he had twice seen laryngeal spasm during administrations of cyclopropane and curare. Not knowing what better to do, he had merely continued manual ventilation until the spasm diminished, which it did in about fifteen minutes. Dr. Troup supported Dr. Marshall's contention that facilities for controlled respiration should be at hand in all cases of thoraco-lumbar sympathectomy, since the pleura could so easily be opened. He was willing to give curare to a patient in the prone posture, since control would be needed anyway and curare rendered it easier of establishment. He had had a limited experience of the tubocurarine produced by Drug Houses of Australia, but found it less potent than that of Burroughs Wellcome. Dr. Troup asked Dr. Marshall whether it was necessary in every case to give a test dose of curare, as suggested by Gray.

DR. R. PRATT (Western Australia) reported some experience of curare with trichlorethylene, but found that it would not do, mainly because manual control was vital to safety with curare, yet was inadmissible with trichlorethylene, which decomposed in an absorption system. One of his patients developed post-anæsthetic atelectasis, which he attributed to deficient ventilation due to inability to use a closed system. Dr. Pratt summarized Knight's technique with thiopentone, curare and nitrous oxide, a technique which he favoured. He gave warning of the possibility, when it was used, of a cumulative effect from the thiopentone. Actually, if the increments of thiopentone were restricted to the recommended size of perhaps 50 milligrammes, accumulation should not occur. Saline should be given by the continuous intravenous drip method in all cases. Since that was a clumsy procedure in short operations, Dr. Pratt had tried various mixtures of thiopentone and curare, mixed directly in the syringe. He was well pleased with the mixture finally achieved. In reply to Dr. Marshall's inquiry as to his experience with procaine as a relaxant, Dr. Pratt said that it was nil, but such an effect had been described in the literature.

Dr. Marshall, in reply, said that he himself did not consider half-hourly supplementary doses of curare to be often needed. In electric shock therapy, the calculated dose of curare should be diluted to 20 millilitres. One-quarter of that amount should be given as a test dose, watch being kept for undue ptosis, weakness of the neck muscles or other evidence of sensitivity. If all was well after a minute or so, the remainder of the calculated dose could be injected. He always employed that tentative method. With regard to the excretion of curare, Dr. Marshall said that he had heard Professor Shaw's views from him personally; at the same time, others had reported that urine from a curarized animal had curarizing properties, so that some excretion through the kidneys must occur. Dr. Marshall asked Dr. Orton what was his largest total dosage of curare.

Dr. Orton said that it was 60 milligrammes in a period of about five hours. His initial dosage was 1·5 milligrammes per stone of body weight. Supplementary doses, one-third the size of the initial dose, were given as needed to control bronchial reflexes, at intervals of about half an hour. A useful test for the impending return of those reflexes was to compress the pilot balloon of the cuffed endotracheal tube; if the patient showed resentment at the increased pressure within the cuff, it was time for a further dose of curare.

Dr. Marshall, in reply to Dr. Troup's question about laryngeal spasm, said that curare would not always prevent it, especially if the concurrent cyclopropane anæsthesia was minimal. For that reason, he was not fond of minimal anæsthesia, preferring a moderate depth, with curare to complete the relaxation. With regard to the routine use of curare, he was reminded of the reply of the Hungarians when the partition of their country was suggested: "No! No! Never!" Curare should be used only in the presence of a reasonable indication. Caution was doubly necessary when it was used for patients in the prone posture. The "heaving behind" of such patients, all too often seen, was indicative of imperfect pulmonary ventilation. Supports should be placed under hips and shoulders so as to remove the body's weight from the thorax and diaphragm; facilities for controlled respiration should be always at hand. Like Dr. Troup, Dr. Marshall was struck by the low potency of the curare supplied by Drug Houses of Australia. He joined issue with Dr. Pratt in regard to rigid formulæ in dosage, as exemplified in Knight's technique: anæsthetic methods must remain flexible for living subjects. Whilst Knight's technique reduced the dosage of thiopentone, it involved heavy dosage of curare. Dr. Marshall considered the evidence for a relaxant effect with procaine to be slender; probably it acted upon the peripheral nervous mechanism, and it was conceivable that "Myanesin" might do the same. It was likely that adrenaline antagonized the action of curare; but its use was, of course, impracticable when the anæsthetic agent was cyclopropane.

The President, from the chair, proposed a vote of thanks, which was duly carried, to Burroughs Wellcome Limited, for the loan of the film "*d*-Tubocurarine Chloride".

Dr. Marshall then demonstrated a Malayan blow-gun, analogous to that used by the Indians of South America. It consisted of a decorated outer tube of bamboo, six and a half feet long and three-quarters of an inch in diameter. Its inner tube had a bore of three-eighths of an inch, and it was highly polished internally. Within this, again, was a wooden pull-through with a cleaning device reminiscent of a modern rifle. The darts were nine and a half inches in length and three thirty-seconds of an inch in diameter. One end was pointed and the other bore a pear-shaped knob of a balso-like wood, of diameter adapted to the bore. The darts, two of which were poisoned with a black mixture said to consist of brucine and cobra venom, were carried in a decorated quiver of bamboo. Below the poisoned tip, each dart was grooved so that it would break on attempted withdrawal from the wound. Each dart had its own compartment, consisting of a tube of bamboo, in the quiver. The lid of the latter and its sling were of vegetable fibre, elaborately plaited. Dr. Marshall demonstrated the method of using the gun. The dart was placed in the end of the tube and tamped with a plug of moss. By tapping the tube, this tamping was made close. The end of the tube was applied to the lips and the breath expelled into the tube in a sudden puff. The dart then emerged from the far end of the tube with considerable velocity, suggesting an effective range of several yards. The gun, with its long barrel, was probably accurate in skilful hands.

DR. G. KAYE (Victoria), on behalf of Dr. D. G. RENTON (Victoria), presented some samples of plastic tubing for use in intravenous therapy. The first, a tube of polyethylene, 0·033 inch in external diameter and 0·025 inch in bore, had been received from Dr. John S. Lundy, of the Mayo Clinic, Rochester, Minnesota. The second, made in Australia from polyethylene, measured 0·035 inch in external diameter and 0·019 inch in bore; it would suffice for the giving of saline solution or penicillin, but not of blood. The third, 0·047 inch in external diameter and 0·026 inch in bore, was that favoured by Dr. Renton. It would traverse with ease a Julian Smith's blood bank needle, 1·6 millimetres in diameter. Its bore, however, was still insufficient for the free passage of blood, and Dr. Renton hoped to arrange with the makers, Moulded

Products, Limited, of Melbourne, for it to be produced in a form having a bore of 0·030 or 0·032 inch. The exhibit included also two examples of Australian-made tubing of "Nylex", respectively 1·8 and 2·6 millimetres in external diameter and 1·0 and 2·0 millimetres in bore. Dr. Renton used them in place of glass canulæ, since they were relatively non-irritating to the vein, were not easily dislodged and were transparent. Dr. Kaye commented briefly upon the many uses of plastic tubing in intravenous therapy. He said that it might be boiled, but not autoclaved. In its smaller sizes it might be inserted into the vein through a suitable intravenous needle, without the need for venesection. It might be used for prolonged administrations of barbiturate anæsthetics or of curare, for transfusions of blood or plasma, for post-operative therapy with penicillin, or for the withdrawal of samples of blood from the heart in physiological investigations. Being comparatively inert, it might be left in a vein for long periods without producing thrombosis. It might be united by one or other of a variety of plastic cements, and being thermo-labile, it was capable of being modified to some extent in form and diameter. Dr. Renton was in close touch with its local manufacturers, and was confident that, if anæsthetists and surgeons would agree upon the most useful sizes, the manufacturers could be induced to supply them.

Special Correspondence.

NORTH AMERICAN LETTER.

FROM OUR SPECIAL CORRESPONDENT.

THIS letter will concern itself chiefly with recent developments in the field of organized medicine and its relation to the public scene. The past month has seen the publication of an important pronouncement from the annual meeting of the Canadian Medical Association in Saskatoon, where we had the pleasure of a visit from the General Secretary of the Federal Council of the British Medical Association in Australia. The background of the pronouncement is briefly this: The public is apprehensive about the cost of medical care and hospitalization in the face of a rising cost of living index since the war. In fact, most family budgets have simply been forced to forget about the spectre of illness, so serious are the inflated cost of goods and the sudden demands for increases in rates by all public utilities, such as railroads, telephone and power companies. There is not a family but realizes, too, that by pooling their risks through some form of insurance, they can meet some of the costs of illness. In Saskatchewan, and later in British Columbia, the provincial governments introduced compulsory hospitalization insurance, to be paid for at a fixed *per capita* cost right across the board, with a maximum of $30 per family. Though there are many situations calling for aspirin in these arrangements, it is fair to say that such hospitalization insurance has been a genuine advance in our medical care picture. The Canadian Medical Association has been happily alive to this, and has recently stated publicly that "the first and most urgent stage in the voluntary health programme should be devoted to meeting the costs of hospitalization for every citizen of Canada". The association concludes: "The C.M.A. will gladly co-operate in the preparation of detailed schemes which have as their object the removal of any barriers which exist between people and the medical services they need and which respect the essential principles of the profession."

As referred to earlier in this correspondence, the College of Physicians and Surgeons of British Columbia entered into an agreement with the Government of British Columbia for the care of indigents. The report of the operation of this scheme for the first three-month period has just been released, and contains a great deal of interesting material. A rate of $14.50 per "social assistance" case was struck, and this money is pooled in a single fund, administered by thirteen doctors from all parts of the province. They have selected a Taxing Committee of five doctors, centrally located, who represent in their number two general practitioners, one eye, ear, nose and throat man, one surgeon and one internist.

A total of 45,470 persons were covered by the scheme, including 25,900 old-age pensioners. Seven hundred doctors submitted 16,000 accounts totalling $187,000. Of this sum 70% was paid to the doctors. Administrative costs were kept down to a creditable 4%. Of the 16,000 accounts, only 2,000 had to come before the Taxing Committee. Every effort has been made to protect the members of this committee from being personally bombarded with complaints for bills censored, and they may only be approached in writing through the official secretary of the scheme. The Taxing Committee has handed down some terse remarks for future guidance. They will not pay for "mileage" within an urban centre or within a radius of five miles of the nearest doctor. The surgeon who gives his own anæsthetics where no other doctor is available, gets a fee for the anæsthetic. One visit per week is considered sufficient for chronic medical cases in hospital, except for flare-ups and complications. The payment of several specialists on one case is stringently reviewed. Excessive laboratory work is also scrutinized. Excessive treatments by injections are also frowned upon. Incomplete case records, too frequent visits in some instances, and accounts filed too late for admission are the thorns in the flesh! But it is an education for us all to see just how efficiently we can run our own show medically, once the funds are provided for us. Physiotherapy, optometrists' services, and treatment in out-patient clinics are matters still under investigation. To date not a single doctor has asked, "When do we get paid?" and there has been only one lay complaint, which speaks well for the scheme.

Of interest to an air-minded country like Australia is the fact that in the past year 250 medical practitioners in civilian life have been given a course in the examination of potential aircraft pilots and crew at the Royal Canadian Air Force's Institute of Aviation Medicine in Toronto.

Correspondence.

TUBERCULIN SKIN TESTING IN RELATION TO B.C.G. VACCINATION.

SIR: Dr. H. W. Wunderly in his timely letter in today's journal emphasizes that only non-reactors to the intracutaneous tuberculin (Mantoux) test should be vaccinated with the B.C.G., and he describes how the test should be carried out. He quotes a brochure published by the Commonwealth Serum Laboratories in which it is recommended that the solution of tuberculin should be injected into the upper part of the front of the forearm.

I prefer to make the injection into the outer side of the arm just below the level of the insertion of the deltoid muscle. I have carried out the test many thousands of times and have made many tests upon myself and I am quite sure that a reaction which is at all sharp causes much more discomfort and irritation in the tissues of the forearm than it does in those of the outer side of the arm. Besides, in women it is more conspicuous and unsightly on the forearm.

With patch tests, one should be sure, of course, that the patches used have not lost potency through age, just as one should be sure that one's solutions of tuberculin have been freshly prepared.

I am sorry that the single-injection technique for the Mantoux test, introduced by Dr. Cotter Harvey and myself in 1938, has not found more general acceptance. The method is to use a concentrated solution of the purified protein derivative of tuberculin (equivalent to a 1 in 100 solution of old tuberculin) in a dose of 0·025 millilitre: the solution is strong enough to elicit a reaction from all reactors (or very nearly all), but is not of sufficient bulk to cause a very sore arm even in the most sensitive. Although the method has not come into general use, it is very reliable and a great saver of time and effort when many persons are to be tested. Also, the sore and unsightly reactions not uncommonly seen with the orthodox technique are of quite rare occurrence.

Yours, etc.,

DOUGLAS ANDERSON.

185 Macquarie Street,
Sydney,
July 30, 1949.

B.C.G. VACCINE.

SIR: The policy of the New South Wales Department of Public Health, which controls supplies of B.C.G. vaccine in this State, in limiting immunization against tuberculosis is open to criticism. As reported by the department, there is now no shortage of the vaccine—the Commonwealth Serum Laboratories in Melbourne are able to supply large quantities. Yet the department will only forward B.C.G. for vaccination

of nurses and medical staffs and known tuberculosis contacts. Vaccinators, registered by the department, who guarantee to perform every detail of the procedure in person and to keep records for the statistical purposes of the department, are the only medical practitioners permitted supplies for the purpose. Though obliging on request, little active effort is being made to instruct and enrol new vaccinators. Why such elaborate precaution in handling a vaccine about which so much is already known from widescale and time-honoured application overseas?

A question of safety? The department states in its brochure that B.C.G. is perfectly safe.

A doubt as to its efficacy? A medical officer of the department in a lecture recently presented American and Scandinavian figures showing that B.C.G. confers a high degree of immunity for a number of years, greatly diminishing infection and reducing mortality. Confirmatory "experiments" in Australia would be redundant.

A matter of expense? B.C.G. is not expensive to produce or administer. It might also be regarded as a national investment, reducing as it must in time the cost of tuberculosis treatment and rehabilitation services.

A question of difficulty? The actual technique of administration of vaccine, its associated Mantoux testing and routine follow-up are undoubtedly simple. As for the short life of the serum of five days only, timely ordering should present no difficulty and the postal department can usually cope.

Fear of public mistrust? Blind prejudice towards immunizations in general is surely a thing of the past. The public might now be said to be "injection-minded". The harmless local reactions which sometimes occur could not seriously be thought to injure the good reputation of the vaccine, especially when each subject is warned of this unfortunate possibility, and immunization is voluntary. That some will contract tuberculosis if the vaccination is inadvertently given in the incubation period is also not hard for patients to understand. Such minor disadvantages weighed against the dread disease itself have certainly not deterred the Scandinavians for many years.

How then can the Department of Public Health justify a policy of restraining the general practitioner, instructed in the procedure, who seeks to immunize susceptible patients desiring this protection for themselves or their children? The answer, as given unofficially by department medical officers, is that the incidence of tuberculosis in Australia is so much lower than in many lands abroad, as not to warrant wider use of B.C.G. here. This view, that you might as well keep the worm in your own apple because your neighbour has more worms in his, seems a poor defence for an authority exercising its control to impose restrictions on the professional use of a prophylactic medicine.

Yours, etc.,

HELEN B. WILES.

4 Blaxland Road,
Bellevue Hill,
New South Wales.

July 25, 1949.

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Number 55, of July 28, 1949.

AUSTRALIAN MILITARY FORCES.

Royal Australian Army Medical Corps.

SX500734 Captain B. F. Venner is transferred to the Reserve of Officers (Royal Australian Army Medical Corps) (4th Military District), 7th May, 1949.

Reserve Citizen Military Forces.

Royal Australian Army Medical Corps.

1st Military District.—Honorary Major D. H. K. Lee is retired at his own request, 31st May, 1949.

5th Military District: To be Honorary Colonel, 21st January, 1949.—Lieutenant-Colonel L. E. Le Souef, E.D.

DISEASES NOTIFIABLE IN EACH STATE AND TERRITORY OF AUSTRALIA AND NOTIFICATIONS FOR THE WEEK ENDED JULY 23, 1949.[1]

Disease.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.	Northern Territory.[2]	Australian Capital Territory.	Australia.[3]
Ankylostomiasis	*	..	1	..	*	..	..	..	1
Anthrax	*	..	..	..	..	..	..	..	..
Beriberi	*	*	*	*	*	*	..	*	..
Bilharziasis	*	..	..	..	..	..	..	..	..
Cerebro-spinal Meningitis	5(3)	2(1)	1(1)	..	..	..	..	..	8
Cholera	..	..	..	..	..	..	..	..	..
Coastal Fever(*a*)	*	*	..	*	*	*	*	*	..
Dengue	*	*	*	*	*	*	..	*	..
Diarrhœa (Infantile)	..	..	10(10)	..	..	..	..	..	10
Diphtheria	8(5)	4(3)	7(1)	..	2	..	..	..	21
Dysentery(*b*)	*	..	1	..	1	..	..	..	2
Encephalitis Lethargica	..	..	..	..	..	..	..	..	..
Erysipelas	*	*	*	1(1)	*	*	..	..	1
Filariasis	*	..	..	..	..	..	..	..	..
Helminthiasis	*	..	*	*	*	*	*	*	..
Hydatid	*	..	*	*	..	*	*	..	..
Influenza	*	*	*	1(1)	*	*	..	*	1
Leprosy	..	..	..	..	..	..	..	..	..
Malaria(*c*)	*	(*c*)	1(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	1(*c*)
Measles	*	*	*	155(56)	*	*	..	..	155
Plague	..	..	..	..	..	..	..	..	..
Poliomyelitis	1	27(15)	1(1)	1(1)	..	*	*	*	30
Psittacosis	*	..	*	..	*	*	*	*	..
Puerperal Fever	..	..	..	..	..	..	..	..	..
Rubella	*	*	*	*	*	*	..	..	..
Scarlet Fever	34(19)	28(15)	7(5)	8(8)	3(2)	2	..	2	84
Smallpox	..	..	..	..	..	..	..	..	..
Tetanus	*	..	..	*	*	*	*	*	..
Trachoma	*	..	*	*	*	*	*	*	..
Tuberculosis(*d*)	26(22)	14(6)	4(2)	10(10)	7(7)	2	..	..	63
Typhoid Fever(*e*)	..	..	..	..	..	..	..	..	..
Typhus (Endemic)(*f*)	..	..	..	..	..	..	..	..	..
Undulant Fever	..	..	..	..	..	..	..	..	..
Weil's Disease(*g*)	*	*	*	*	*	*	*	*	..
Whooping Cough	*	*	*	8	*	*	..	..	8
Yellow Fever	..	..	..	..	..	..	..	..	..

[1] The form of this table is taken from the *Official Year Book of the Commonwealth of Australia*, Number 36, 1944-1945. Figures in parentheses are those for the metropolitan area.
[2] Figures not available.
[3] Figures incomplete owing to absence of returns from the Northern Territory.
* Not notifiable.
(*a*) Includes "Mossman" and "Sarina" fevers. (*b*) Includes amœbic and bacillary. (*c*) Statistics inexact with varying practice with regard to relapses in Service cases infected overseas. (*d*) Includes all forms except in New South Wales and Northern Territory, where only pulmonary tuberculosis is notifiable. (*e*) Includes enteric fever, paratyphoid fevers and other Salmonella infections. (*f*) Cases reported are all of the mild type known as Brill's disease or endemic typhus (including scrub and urban types). (*g*) Includes leptospiroses, Weil's and para-Weil's disease.

ROYAL AUSTRALIAN AIR FORCE.

Reserve: Medical Branch.

John Edward Joseph (257661) is reappointed to a commission with the temporary rank of Squadron Leader, 10th May, 1949.

Medical Prizes.

AUSTRALIAN ORTHOPÆDIC ASSOCIATION PRIZE.

THE Australian Orthopædic Association has decided to found a prize to be known as the Australian Orthopædic Association Prize. The prize will be 25 guineas. It will be awarded every two years for an original unpublished essay on some orthopædic subject which shall be either chosen by the committee of the society or left to the choice of the candidate. On the first occasion the choice will be left to the candidate. Entrants for the prize may be either sixth year medical students or graduates of not more than five years' standing. The essay shall not contain more than 5000 words. The committee of the society retains the right to withhold the prize if no essay of sufficient merit is submitted. The copyright of the essay shall be the property of the Australian Orthopædic Association. Essays must be typewritten with double spacing and must be submitted in triplicate and forwarded under a pseudonym to the Honorary Secretary, Dr. A. R. Hamilton, 135 Macquarie Street, Sydney. A separate sealed envelope should be enclosed containing the name and address of the candidate, together with the pseudonym used. Entries for the first prize will close on March 31, 1950.

Obituary.

EDWARD BROOKE THOMAS.

WE regret to announce the death of Dr. Edward Brooke Thomas, which occurred on July 28, 1949, at Eudunda, South Australia.

HIBBERT ALAN STEPHEN NEWTON.

WE regret to announce the death of Sir Hibbert Alan Stephen Newton, which occurred on August 4, 1949, at Melbourne.

Notice.

A REQUEST has been received for a copy of THE MEDICAL JOURNAL OF AUSTRALIA of May 24, 1941. Any reader who has a copy of this issue and is willing to dispose of it, is asked to communicate with the Editor.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Witts, Fannie Eva, M.B., Ch.M., 1923 (Univ. Sydney), 21 Burns Road, Wahroonga.

Brady, Peter Martin Carroll, M.B., B.S., 1947 (Univ. Sydney), Flat 6, 15 Lytton Street, North Sydney.

Medical Appointments.

Dr. H. R. G. Barrett has been appointed deputy medical superintendent, Brisbane Mental Hospital, Goodna, in pursuance of the provisions of *The Public Service Acts*, 1922 to 1948, and *The Mental Hygiene Act of* 1938, of Queensland.

Dr. W. D. Rimmer has been appointed government medical officer at Mount Isa, Queensland.

Dr. P. N. Jenkin and Dr. R. W. E. Manser have been appointed Public Vaccinators of Victoria.

Dr. J. S. Stewart has been appointed assistant medical superintendent at the Royal Adelaide Hospital, Adelaide.

Diary for the Month.

AUG. 16.—New South Wales Branch, B.M.A.: Medical Politics Committee.
AUG. 17.—Western Australian Branch, B.M.A.: General Meeting.
AUG. 18.—New South Wales Branch, B.M.A.: Clinical Meeting.
AUG. 18.—Victorian Branch, B.M.A.: Executive Meeting.
AUG. 23.—New South Wales Branch, B.M.A.: Ethics Committee.
AUG. 24.—Victorian Branch, B.M.A.: Council Meeting.
AUG. 25.—New South Wales Branch, B.M.A.: Branch Meeting.
AUG. 26.—Queensland Branch, B.M.A.: Council Meeting.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135 Macquarie Street, Sydney): Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester United Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phœnix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225 Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178 North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205 Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia. All government appointments with the exception of those of the Department of Public Health.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

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